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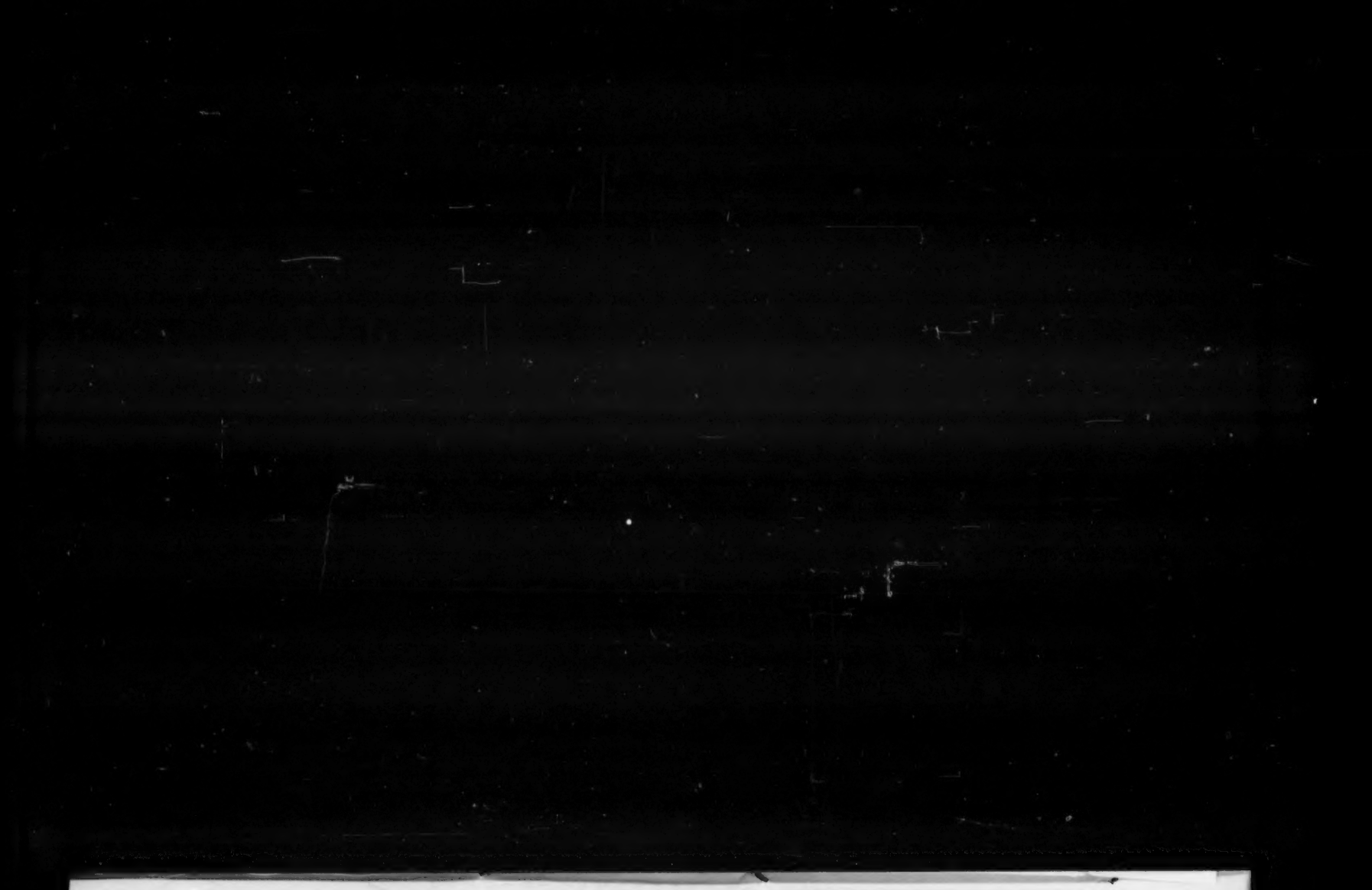

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AMERICAN ANTIQUITY

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STATISTICAL TECHNIQUES FOR THE DISCOVERY OF ARTIFACT TYPES

ALBERT C. SPAULDING

WITHIN RECENT YEARS there appears to have been an increasing awareness on the part of archaeologists that certain statistical techniques offer economical methods of extracting information of cultural significance from archaeological data. The discussions of Kroeber (1940), Robinson (1951), and Brainerd (1951) have appeared in *American Antiquity*, and the last two even evoked a comment* (Lehmer, 1951). In addition to these papers, which are primarily devoted to exposition of method, a considerable number of special applications can be found in the literature. Archaeological research inevitably brings the researcher face to face with the problems of ordering and comparing quantities of data and of sampling error. There seems little doubt that the best approach to these problems involves a search of statistical literature for appropriate methods.

The discussion which follows is an attempt to apply certain statistical methods to the discovery and definition of artifact types and to suggest other applications to related problems. No effort has been made to explain such important statistical concepts as population, random sample, sampling error, and so on; these explanations are the proper function of textbooks, and any paraphrasing here would be presumptuous. I am indebted to Paul S. Dwyer, Consultant in the Statistical Research Laboratory of the University of Michigan, for reading and commenting on an earlier version of the manuscript.

The artifact type is here viewed as a group of artifacts exhibiting a consistent assemblage of attributes whose combined properties give a characteristic pattern. This implies that, even within a context of quite similar artifacts, classification into types is a process of discovery of combinations of attributes favored by the makers of the artifacts, not an arbitrary procedure of the classifier. Classification is further an operation which must be carried out exhaustively and independently for each cultural context if the most fruitful historical interpretations are to be made. It is the primary purpose of this paper to argue that with the aid of suitable statistical techniques the degree of consistency in attribute combinations can be discovered in any meaningful archaeological assemblage provided sufficient material is at hand, and hence that valid types can be set up on the basis of analysis of material from one component.

Wholesale acceptance of these views entails modification of a widely held concept of typology which has been clearly expressed by Krieger (Krieger, 1944; Newell and Krieger, 1949). Under this concept, the method employed to demonstrate the existence of a valid type is a site-to-site comparison to show consistency of the identifying pattern, range of variation, and historical relevance. In the absence of a method for investigation of consistency and range of variation within the site, this is indeed the only convincing technique available for validation of a proposed type. On the other hand, the presence of an adequate method for investigating consistency and range of variation within the site obviates a comparative study so far as the questions of the existence and definitive characteristics of a type are concerned. Historical relevance in this view is essentially derived from the typological analysis; a properly established type is the result of sound inferences concerning the customary behavior of the makers of the artifacts and cannot fail to have historical meaning. This is not meant to imply that corroborative evidence from the other sites would not be welcome in the case of a dubious type, i.e.,

* See pp. 341-53 in this issue for an application of the Robinson technique.

one which is on the borderline of probability owing to a deficient sample or lack of clear evidence of attribute clustering, nor is it meant to imply that the classifier is relieved of the responsibility of avoiding synonymy. Finally, it is not intended to assert that artifact types are the only useful units of attribute association for site-to-site comparison; numerous examples of good comparative work with body sherds are sufficient refutation of such an assertion, although the common practice of failing to distinguish between kinds of body sherds and types of vessels is a stumbling block in understanding the cultural meaning of a comparison. It should be pointed out that this discussion owes much to the expositions of Rouse (1939, especially pp. 9-23), Krieger (1944), Newell and Krieger (1949, pp. 71-74), and Taylor (1948, especially pp. 113-130).

The customary technique of classification consists of inspection and segregation of obtrusive combinations, or occasionally of attempting to describe all of the observed attribute combinations on an equal basis. Categories resulting from both of these methods are called "types," although they are not exactly comparable. Both methods fail to yield surely artifact types in the sense in which the term is used here. In the first case, segregation of obtrusive combinations, the cultural implications of the data are usually not exhausted, although under favorable circumstances all of the types may be discovered and described. In the second case, description of all combinations, the problem of typology is not faced at all; some of the "types" described will in all probability consist of combinations habitually avoided by the makers of the artifacts. Questions of typology arise, of course, only in a situation where a considerable variety exists within a group of generally similar artifacts — it is obvious that a stone projectile point and a pottery vessel belong in two separate artifact types. But within a group of similar artifacts the propriety of division into more than one type may be anything but obvious. It follows from the concept of the type adopted here that a pronounced association of two attributes is the minimum requirement for the demonstration of the existence of an artifact type, since two is the smallest number which can be considered an assemblage.

Application of this concept to concrete material can be illustrated by a few simple examples. Inspection of a collection of 100 vessels which represent all the pottery from a component results in the noting of the following attributes: smooth surface, cord wrapped paddle stamped surface, grit tempered paste, and shell tempered paste. The question to be answered is whether the vessels represent one or two pottery types with respect to these attributes. The data necessary to answer the question are the frequencies of vessels in each of the four possible categories into which two pairs of alternatives can be grouped, here smooth surface and grit temper, smooth surface and shell temper, cord wrapped paddle stamped surface and grit temper, and cord wrapped paddle stamped surface and shell temper. Table 7 presents these frequencies in 2 x 2 form under the assumption that the count in each category is 25 vessels.

TABLE 7. FOUR-CELL FREQUENCIES WITH NO ASSOCIATION OF ATTRIBUTES

	Grit Temper	*Shell Temper*	*Total*
Stamped Surface	25	25	50
Smooth Surface	25	25	50
Total	50	50	100

It is evident by inspection that the 100 vessels cannot be separated into two types under these circumstances. The cord wrapped paddle stamped vessels are equally divided with respect to grit temper and shell temper, the same is true of the smooth surfaced vessels, and conversely both the shell tempered and the grit tempered vessels are equally divided with respect to surface finish. A mathematical statement to the same effect can be obtained by applying the simple and useful four-cell coefficient of association described by Kroeber (1940). If the upper left cell is designated *a*, and the upper right cell *b*, the lower left cell *c*, and the lower right cell *d*, the coefficient of association for the attributes grit temper and cord wrapped paddle stamped surface would be computed as

$$\frac{(a+d)-(b+c)}{a+b+c+d} = \frac{(25+25)-(25+25)}{25+25+25+25} = \frac{0}{100} = 0.$$

The same result would follow for the other three pairs. The opposite situation would be that of Table 8. Here there are plainly two types with respect to the traits considered, a cord wrapped paddle stamped and grit tempered type and a smooth surfaced and shell

TABLE 8. FOUR-CELL FREQUENCIES WITH PERFECT ASSOCIATION OF ATTRIBUTES

	Grit Temper	Shell Temper	Total
Stamped Surface	50	0	50
Smooth Surface	0	50	50
Total	50	50	100

tempered type. The computed coefficient of association for the attributes grit temper and cord wrapped paddle stamped surface is

$$\frac{(50 + 50) - (0 + 0)}{50 + 0 + 50 + 0} = +1.0,$$

and the same coefficient would be obtained for the shell tempered, smooth surfaced category. On the other hand, the calculation for the smooth surfaced, grit tempered category shows

$$\frac{(0 + 0) - (50 + 50)}{0 + 50 + 0 + 50} = -1.0,$$

and this is also true of the cord wrapped paddle stamped, shell tempered category.

This discussion of four-cell coefficients has been introduced chiefly to illuminate the concept of the two attribute association as the minimum requirement for the establishment of an artifact type, although the simple four-cell coefficient of association and its more sophisticated relatives are by no means to be ignored as working methods under the proper conditions. One of the serious deficiencies of the four-cell coefficient is its failure to consider the vagaries of sampling, since a conservative interpretation of the material from any archaeological component requires that it be considered no more than a sample drawn from a universe of artifacts manufactured by a society over some vaguely defined period of time. Other precautions to observe when using four-cell coefficients are discussed by Kroeber (1940).

Methods do exist which give answers expressing the combined result of the error involved in sampling and the extent to which the observed data fit the expected with respect to a hypothesis. The remainder of this paper will be devoted to illustrating the application of these methods to typological problems and some other archaeological data. All of the techniques presented are drawn from the literature of biological statistics dealing with the analysis of binomial distributions, especially the discussions of Mather (1947, Chapter XI) and Snedecor (1946, Chapters 9 and 16), and the reader is referred to these sources for an adequate explanation of the underlying concepts. The most practical method of recording and subsequently extracting the variety and quantity of data needed for a thorough analysis of any sizable collection would appear to be one of the mechanically or electrically sorted punch card systems.

TABLE 9. FOUR-CELL FREQUENCIES WITH INDEPENDENCE OF ATTRIBUTES

	Grit Temper	Shell Temper	Total
Stamped Surface	53	64	117
Smooth Surface	32	43	75
Total	85	107	192

. Using Table 9 as an example, an analysis which fulfills the stipulated conditions can be made by means of a formula for computing a statistical entity known as chi square. The formula which is most convenient for a 2 x 2 table is

$$\chi^2 = \frac{n(ad - bc)^2}{(a + b)\ (c + d)\ (a + c)\ (b + d)},$$

or verbally, the number of specimens multiplied by the squared difference of the product of the diagonals divided by the product of the marginal totals. Substituting the values of Table 9 gives

$$\chi^2 = \frac{192\ [\ (53 \times 43) - (35 \times 64)\ ]^2}{117 \times 75 \times 85 \times 107},$$

which reduces to

$$\frac{192 \times 231 \times 231}{117 \times 75 \times 85 \times 107} = 0.128.$$

With a χ^2 of 0.128 and one other argument, the number of degrees of freedom, it is possible to enter a table of χ^2 and read the probability of the occurrence of so large a χ^2 through the operation of sampling variation alone in a population having independent attributes in the ratios indicated by the marginal totals. The appropriate number of degrees of freedom is 1 because the computation imposes the restriction that the frequencies must add up to the marginal totals, so that as soon as a frequency is assigned to any cell those of the other three can be found by subtraction. The probability corresponding to a χ^2 of 0.128 with 1 degree of freedom is between .80 and .70, which means that a χ^2 this large would arise by chance alone between 70 and 80 times in 100 in a population having independent attributes.

It seems reasonable to accept the hypothesis of independence of attributes and conclude that the marginal totals present a fair picture of the potters' habits, there being very little evidence that the individual cell frequencies fall outside the range expected in a random drawing from a homogeneous population having the proportions of attributes indicated by the marginal totals. In other words, there is no discernible tendency for the attributes to cluster into types. Here, in contrast to the coefficients of association mentioned above, it has been possible to make a statement in terms of numerical probability and a definite hypothesis, which reduces the data to their most comprehensible form.

Chi square for Table 8 would be computed as

$$\frac{100\,[\,(50 \times 50) - (0 \times 0)\,]^2}{50 \times 50 \times 50 \times 50} = 100,$$

a value exceeding by a large amount the tabled value of 10.877 for a probability of .001 for 1 degree of freedom, and the probability that the marginal totals fairly represent the potters' habits is astronomically remote. The attributes are not independent; inspection of the table shows that the sample is derived from two populations, one characterized by grit tempering and a cord wrapped paddle stamped surface, the other by shell tempering and a smooth surface. This is the same conclusion as that based on the coefficient of association, but again a numerical expression of the odds against the occurrence of such a distribution in a random drawing from a population having an independent distribution of the four attributes has been provided.

It is important to note that the proportions used in testing attribute independence or lack of it were derived from the sample, and consequently the calculations have not tested the proposition that the observed proportions exactly represent those of the population from which the sample was obtained. What has been tested is the hypothesis that the two samples, those in the two rows or the two columns, were randomly drawn from a common binomial population. In the first instance (Table 9) the hypothesis was accepted, in the second (Table 8) it was rejected. Acceptance in the case of the data of Table 9 indicates that both cord wrapped paddle stamped and smooth surfaced vessels were randomly drawn from a population of vessels having grit temper and shell temper in a ratio estimated to be in the neighborhood of 85:107, or alternatively, both grit tempered and shell tempered vessels were randomly drawn from a population of vessels having cord wrapped paddle stamped and smooth surfaces in a ratio estimated to be 117:75. The estimated ratios are simply the marginal totals, and the inferences about the nature of the parent population can be completed by finding confidence limits for these estimates. This can be accomplished easily by means of a calculation or by reference to a table of confidence intervals such as that presented by Snedecor (1946, p. 4). Rejection of the hypothesis of independence in the case of Table 8 leads to the conclusion that cord wrapped paddle stamped vessels were drawn from a population of vessels estimated to be exclusively grit tempered, and smooth surfaced vessels were drawn from a probably exclusively shell tempered population. Again confidence intervals can be assigned to the estimates.

The next question to be investigated is that of a suitable technique for situations involving combinations of more than two pairs of attributes. The method to be employed is closely related to that just illustrated, but the resemblance is obscured by the streamlined computing routine used for the 2 x 2 table. There are two basic steps required: (1) calculation of an expected frequency for the combination, customarily under the hypothesis that the combination in question does not constitute a distinctive type, i.e., that the attributes making up the combination have independent distributions; and (2) comparison of the expected frequency with the observed frequency to determine whether or not the difference between the two can be reasonably attributed to sampling error. If the observed frequency exceeds the expected frequency by an amount too great to be considered the result of mere sampling error, it will be concluded that a genuine tendency for the makers of the artifacts to combine the attributes in question has been discovered — that the existence of a type has been demonstrated.

The following data will be used to explain the working method: in a collection of 297 pottery vessels, it is suspected that a combination of grit tempering, stamped surface, and a collared rim occurs often enough to provide sufficient grounds for the definition of a pottery

type. A count made of the frequency of the triple combination gives 83 vessels; of the frequency of grit tempering alone, 117 vessels; of stamped surface alone, 91 vessels; and of collared rims alone, 136 vessels.

Under the hypothesis of independent distribution of attributes (no type), the frequency of the combination would be expected to be a simple function of the relative frequencies of the component attributes. Calculation of the expected number is a straightforward problem in compound probability, here

$$\frac{117}{297} \times \frac{91}{297} \times \frac{136}{297} \times \frac{297}{1} = 16.42 \text{ vessels.}$$

In practice it is necessary to compute the proportion (p) characteristic of the combination for reasons to be explained below. The computation of p here is

$$\frac{117}{297} \times \frac{91}{297} \times \frac{136}{297} = .0553.$$

The next step is to obtain the deviation (d) of the observation from the expectation by subtracting 16.42 from 83.00, which results in a deviation of 66.58.

It is necessary here to introduce some new symbols required for the final comparison of the expected frequency (E) and the observed frequency (O). The proportion of vessels not expected to exhibit the combination will be designated q, which is simply $1-p$ or $1.000-.0553=.9447$ in the example. The expectation for the various possible frequencies of two alternative types (in this example grit tempered, cord wrapped paddle stamped, collared rim vessels and vessels not having this combination) can be found by expanding the binomial $(p+q)^k$, where k is the symbol for the number of individuals in the group (297 vessels); in addition, and of immediate importance in the solution of the problem, is the fact that the variance of the expanded binomial distribution is pqk ($.0553 \times .9447 \times 297 = 15.52$). The standard deviation (σ) is $\sqrt{pqk}$, which makes it possible to compute easily either the deviate in units of standard deviation as $\frac{d}{\sigma}$, or $\left[\frac{d}{\sigma}\right]^2$ as $\frac{d^2}{pqk}$. Both $\frac{d}{\sigma}$ and $\left[\frac{d}{\sigma}\right]^2$ can be converted into statements of probability by means of widely available tables.

In the case of d/σ, tables of areas of the normal curve or tables for t for infinite degrees of freedom may be used; $(d/\sigma)^2$ is the familiar χ^2 for 1 degree of freedom. Choice of formula is a matter of individual preference since the answers obtained are identical; tables for χ^2 are less closely computed than those for d/σ owing to their two dimensional character, but the precision of the latter does not appear to have any advantage for archaeological purposes. In both cases the tables were computed on the basis of a continuous curve rather than the binomial curve with discrete steps used here, and consequently they are not exactly applicable. A widely recommended procedure for avoiding excessive distortion is to group categories so that the expected numbers are not too small, say 5 or less. A partial correction (the Yates correction) can be made by adjusting d, and precise methods of adjustment for small numbers can be found in statistical literature. The simple adjustments do not seem to change the results markedly, but anyone planning to use these techniques should be familiar with informed discussions of the subject.

Calculations for $(d/\sigma)^2$ for the example are

$$\frac{(66.58)^2}{15.52} = \frac{4432.90}{15.52} = 285.62.$$

Entering a table of χ^2 with this figure and 1 degree of freedom, a probability of finding a fit with hypothesis through chance at least as bad of very much less than .001 is noted. A similar calculation for d/σ indicates that the odds are actually less than 1 in 400,000,000,000 that so large a difference between observed and expected frequencies would arise through random sampling in the expanded binomial. It can be concluded that the chance of a sampling vagary as the explanation is exceedingly remote, and the large number of vessels exhibiting the combination must be attributed to the habits of the potters. The calculation does show that a pottery type exists. Further research would be necessary to investigate whether (1) on the basis of other attributes it might not be possible to identify a group of pottery types sharing the specified combination, or (2) whether there are other combinations differing by only one attribute which should be included in the type description as variants. The original conclusion — that the existence of a pottery type was demonstrated — is not modified by either case.

The evaluation of probability can perhaps be clarified by two other examples. Had the observed frequency been 24 vessels, χ^2 would have been computed as

$$\frac{(7.58)^2}{15.52} = \frac{57.46}{15.52} = 3.70,$$

which for 1 degree of freedom represents a probability of between .10 and .05, but much closer to .05. The conclusion is not at all clear. There is an appreciable chance that no real preference for the combination was exhibited by the potters, and the evaluation must be made with the aid of all the experience which the archaeologist can muster. If related sites plainly show that the combination is elsewhere a valid type, the interpretation would probably be that in this case the type was just appearing or disappearing. In the absence of other data, one could say only that there is a very good possibility that a type has been discovered. In certain types of statistical investigation a χ^2 of more than 3.841 (the .05 level of probability for 1 degree of freedom) is considered significant, or in our terms the hypothesis of independence would be rejected. It would appear unwise to carry over blindly such concepts into archaeology. Had the observed frequency of the combination been 8 vessels, d would have been 8.42 and $\chi^2 = 4.57$ with a probability between .05 and .02. The same general reasoning applies again, but here the situation is reversed because the expected frequency exceeds the observed frequency; there is a strong probability that the potters tended to avoid the combination, and the examples observed might best be considered the work of unorthodox potters.

A thorough investigation of a collection requires the calculation of d/σ or χ^2 for every possible combination of presumably important attributes. The number of combinations possible can be found by grouping the mutually exclusive attributes and multiplying together the number of attributes in each of the groups. If the groups of attributes consist of (1) smooth surface, stamped surface; (2) incised rim, plain rim; (3) incised lip, plain lip; and (4) bowl shape, jar shape; the computation is $2 \times 2 \times 2 \times 2 = 16$ possible combinations. If the groups are (1) smooth surface, stamped surface; (2) rectilinear incising on shoulder, curvilinear incising on shoulder, plain shoulder; and (3) grit tempered, shell tempered; there are $2 \times 3 \times 2 = 12$ possible combinations. These 12 combinations will be used in an example with the following data given: total number of vessels (k), 186; frequency of smooth surface, 121 vessels; of stamped surface, 65 vessels; of rectilinear pattern incised on shoulder, 47 vessels; of curvilinear pattern incised on shoulder, 28 vessels; of plain shoulder, 111 vessels; of grit tempering, 70 vessels; and of shell tempering, 116 vessels. Combination counts and computations are shown in Table 10. The computations are exactly like those described above. For example, p in the first combination is

$$\frac{121}{186} \times \frac{47}{186} \times \frac{70}{186} = .0619.$$

The expected number (E) is $186 \times .0619 = 11.51$, and so on.

TABLE 10. COMPUTATION OF $\frac{d^2}{pqk}$ FOR TWELVE COMBINATIONS OF ATTRIBUTES

Attribute Combination	O	*E*	*d*	d^2	*pqk*	$\frac{d^2}{pqk}$
Sm. surf., rect. sh., grit t.	0	11.51	−11.51	132.02	10.78	12.25
Sm. surf., curv. sh., grit t.	2	6.84	−4.85	23.52	6.59	3.56
Sm. surf., plain sh., grit t.	14	27.17	−13.17	173.45	23.21	7.47
Sm. surf., rect. sh., shell t.	38	19.07	+18.93	358.35	17.11	20.94
Sm. surf., curv. sh., shell t.	26	11.36	+14.64	214.33	10.66	20.11
Sm. surf., plain sh., shell t.	41	45.04	−4.04	16.24	34.13	0.48
St. surf., rect. sh., grit t.	3	6.18	−3.18	10.11	5.97	1.69
St. surf., curv. sh., grit t.	0	3.68	−3.68	13.54	3.61	3.75
St. surf., plain sh., grit t.	51	14.60	+36.40	1324.96	13.45	98.51
St. surf., rect. sh., shell t.	6	10.25	−4.25	18.06	9.69	1.86
St. surf., curv. sh., shell t.	0	6.10	−6.10	37.21	5.90	6.31
St. surf., plain sh., shell t.	5	24.20	−19.20	368.26	21.04	17.50
Total	186	186.00	0.00			

Table 10 is to be interpreted simply as a list of χ^2 values, each of which has its corresponding probability for 1 degree of freedom. The individual χ^2 values, computed as d^2/pqk, do not have additive properties in contrast to the contingency table discussed below. Interpretation in terms of pottery types follows the principles already discussed. Three combinations have large positive deviations and large χ^2 values with probabilities well beyond the .001 level. These are stamped surface, plain shoulder, grit temper; smooth surface, curvilinear incised shoulder, shell temper; and smooth surface, rectilinear incised shoulder, shell temper. The last two combinations differ by only one attribute, and hence are to be lumped in one type. The same is true of the smooth surfaced, plain shouldered, shell tempered combination, which is important numerically but has a very small χ^2 value. Accordingly, there is definitely a smooth surfaced, shell tempered type having three kinds of shoulder treatment in a ratio estimated to be about 26:38:41. This can be confirmed by calculating a χ^2 for a 2×2 table testing the degree of association of smooth surface and shell temper. It will be found that they are very strongly associated, as are grit temper and a stamped surface. It can be inferred that the indifferent χ^2 value (0.48) of the shell tempered, plain shouldered, smoothed surface combination is the result of the fact that plain shoulders are shared with and are rather more characteristic of the stamped surfaced, grit tempered combination. This conclusion is at sharp variance with conventional type analysis, where the shell tempered, plain shouldered, smooth surfaced combination would almost surely be distinguished as a separate type, as would the other two smooth surfaced, shell tempered combinations. The calculations above are intended to be an objective demonstration that the fundamental pattern of the type is the smooth surfaced, shell tempered vessel. Shoulder treatment can be described only in terms of estimated ratios of a group of mutually exclusive attributes.

The stamped surfaced, plain shouldered, grit tempered vessels constitute a second definite type; χ^2 for the combination is very high (98.51) and it can be shown that stamped surface and grit temper are strongly associated. The 14 vessels having smooth surfaces, plain shoulders, and grit temper would not be assigned to either type; they are genuinely intermediate and would be so described. The same reasoning applies to the 5 vessels having stamped surfaces, plain shoulders, and shell tempering. The remaining few vessels share two attributes with one or the other of the types and would be assigned accordingly as somewhat aberrant examples. Combinations of this sort, characterized by negative deviations and crossing over of attributes from two types, offer interesting evidence on the degree of conventionality of the potters. In this connection the combinations with a frequency of 0 are highly informative.

A second sort of table can be computed which offers summary evidence on the total pottery making habits of the group. For this table, the individual contribution of each combination would be computed as d^2/E, which for the first combination of Table 10 is 132.02/11.51. The total of these contributions is a χ^2 value for the 12 combinations taken together, for which a probability can be found in the χ^2 table using 7 degrees of freedom. A verbal explanation of the appropriateness of 7 degrees of freedom is too cumbersome for inclusion here, and a clear graphic presentation of a $2 \times 3 \times 2$ table is also difficult, but it can be stated that the particular restrictions imposed by the attribute totals used as basic data allow 7 of the 12 cells of the table to be filled in freely within the general limitations of the attribute totals. The remaining five can be determined by subtraction and hence do not contribute to the degrees of freedom. A χ^2 computed in this manner gives an over-all measure of the tendency of the potters to group attributes and offers cogent material for comparison with other sites having the same categories. Other sorts of comparisons between sites can be made by using the observed number for each combination from one site as the expected number for the other and calculating the resulting χ^2 or by calculating a χ^2 testing the proposition that both sets of observed values could reasonably be considered random samples from a common population. The latter process is illustrated below in the example dealing with the problem of site homogeneity (Table 12).

All of the examples have been concerned exclusively with attributes which are physical properties of the artifacts. It is well known, however, that artifacts have other kinds of at-

tributes, notably provenience, which can be pertinent evidence for the existence of a type. Thus a site might yield two kinds of vessels which differed only in the presence or absence of a single physical attribute, say a lip flange on one. If nothing but physical properties were considered, both kinds would be included in one pottery type because a difference of one attribute is not sufficient evidence for separation. But if the flanged lip appeared only on vessels found in graves and the plain lip was confined to village debris, it would be obvious that the potters had in mind two types with different functional connotations. Provenience furnishes the second attribute required to differentiate two types. The attributes "found in graves" and "found in village refuse" can be included in a probability calculation in exactly the same way as can any physical property of an artifact.

An example, this time not fictitious, of the application of this technique to a non-typological problem will be presented. The data of Table 11 are from the Columbia University excavations at the Arzberger Site, Hughes County, South Dakota, and summarize provenience data of grooved paddle stamped body sherds and other types of surface finish. The

TABLE 11. SURFACE FINISH OF BODY SHERDS BY PROVENIENCE, ARZBERGER SITE, SOUTH DAKOTA

Excavation Unit	*Surface Finish*		
	Grooved Paddle Stamped	*Other*	*Total*
House I	396	1,279	1,675
House II	135	546	681
House III	172	532	704
House IV	178	657	835
Ditch	0	4	4
Unknown	22	79	101
Total	903	3,097	4,000

problem to be investigated is one of site homogeneity. If the site is homogeneous, one excavation unit should be much like another within the limits of sampling error. With respect to the data given on surface finish of body sherds, a hypothesis of independence can be set up: the proportion of grooved paddle stamped sherds will be a function of the frequency of the totals and will be independent of the locus from which the sample is drawn if the site is truly homegeneous. Chi square is computed by the d^2/pqk method used above, although this is not the most common technique for a 2 x n contingency table such as is given. The value of p is $903/4{,}000 = .2258$, $q = .7742$, and k is successively the total number of sherds for each sample. The values are shown in Table 12 (a few rounding errors have not been adjusted). The result is good evidence that the

TABLE 12. TEST OF HOMOGENEITY OF EXCAVATION UNITS, ARZBERGER SITE, SOUTH DAKOTA

	O	E	d	d^2	pqk	$\frac{d^2}{pqk}$
House I	396	378.21	17.79	316.48	292.81	1.08
House II	135	153.77	18.77	352.31	119.05	2.96
House III	172	158.96	13.04	170.04	123.07	1.38
House IV	178	188.54	10.54	111.09	145.97	0.76
Other[1]	22	23.70	1.70	2.89	18.35	0.16
Total	903	903.00				$\chi^2 = 6.34$

[1] The expected frequency for "Ditch" is less than 6, and accordingly it is incorporated in a new category by adding its value to "Unknown."

hypothesis of independence is correct. Individual values are small, and the total for 4 degrees of freedom (this is a 2 x 5 contingency table) corresponds to a probability of between .20 and .10, which does not give any very convincing reason to suspect significant differences in the various excavation units. It can be concluded that so far as the evidence at hand is concerned, the site may reasonably be considered the product of a single occupation over a restricted period of time.

An attempt to appraise the usefulness of this approach to typological and related problems should consider the amount of labor necessary in making the computations. In view of the general availability of computing machines, this seems trivial. The writing of the exposition was far more tedious than the computing of the examples. There is a great deal of work required in making, recording, and assembling the observations needed for a thorough study, but this is not the fault of the statistical methods. It is rather an inevitable part of any detailed study. The methods of calculation used here were selected on a basis of clarity of exposition, not economy of labor; those interested in computing routine are referred to the statistical textbooks cited.

With regard to the more serious question of general usefulness, these are the methods generally recommended for handling data of this sort, although no claim is made that the particular procedures illustrated here completely exhaust the resources of statistics. The information derived from them is important

in an earnest attempt to discover the cultural significance inherent in archaeological remains, and there is no other way in which such information can be obtained. There is no magic involved, however; the usefulness of the result is entirely dependent upon the wisdom with which attributes are observed and investigated and on the relevance of the context to meaningful archaeological problems. Moreover, the inference to be drawn from a statement of probability is sometimes not altogether clear, but at least the degree of uncertainty is put into objective form.

A source of uncertainty which has been mentioned is the fact that the proportions on which the hypothesis of independence is evaluated are derived from the sample and hence are themselves subject to sampling error. This difficulty is inescapable; we can work only with the samples we have, and the observed proportions are surely the best estimate of the proportions of the population, the properties of which must be inferred from the sample. Nevertheless, the cautious student will interpret his results with one eye on a table of confidence limits. To add to this uncertainty, the dimensions of which can at least be estimated on the basis of statistical theory, there is the purely archaeological problem of the nature of the relationship of the sample to the living culture which produced the artifacts. The whole problem is summarized by the often repeated warning that statistics are never a substitute for thinking. But statistical analysis does present data which are well worth thinking about.

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THE SCOTT SITE, LE FLORE COUNTY, OKLAHOMA

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ALTHOUGH CONSIDERABLE archaeological excavation has been conducted throughout eastern Oklahoma during the past fifteen years, it is only recently that attempts have been made to present a chronological framework for the area (Orr, 1946; Krieger, 1946, 1947; Newell and Krieger, 1949; Bell and Baerreis, 1951). Within this framework of prehistory, the latter portions such as those represented by the Gibson and Fulton aspects are probably the best understood. With a single exception (Baerreis, 1951), the earlier cultures remain relatively incognito. One of these early cultures is commonly referred to as Fourche Maline. Unfortunately, however, the Fourche Maline materials remain to be clearly described and identified.

Throughout the years prior to 1946, a large number of archaeological sites located in the Fourche Maline and Poteau river valleys were excavated by the Department of Anthropology at the University of Oklahoma. Most of these sites were characterized by black earth middens which contained burials and village debris. The sites were generally similar in appearance and in the types of artifacts found; because they did not appear to be related to other known cultures in the area, and since they did seem to be related to each other in some way, the total complex of represented traits has been termed Fourche Maline. One of these sites, the Williams mound, has been used to characterize the Fourche Maline materials since it affords about the only published data (Newkumet, 1940). It remains to be demonstrated that the Williams mound represents a single component of what can be termed Fourche Maline and to define and validate the Fourche Maline complex. This should be done, preferably, by establishing a Fourche Maline focus composed of several specific sites or components. Such an undertaking is beyond the scope of this paper, but the following data have considerable bearing on the matter and should afford a step toward the above goal.

The complex included under the term Fourche Maline (Krieger, 1947; Bell and Baerreis, 1951) is characterized by the following traits: The sites are located along the stream banks and consist of large accumulations of village debris representing midden deposits. The middens are characterized by a black earth which contains considerable amounts of mussel shells, animal bones, fire cracked stones, various artifacts, burials, occasional occupational surfaces and other miscellaneous objects. No evidence of house patterns has been uncovered although scattered post holes are found at most sites. Burials are the most common feature encountered within the sites; these are usually in a fully flexed position, and the burials contain one or several individuals with grave offerings being rather rare. Dog skeletons are reported and do not appear to be an unusual feature at these sites. The artifacts are of many types and for the most part are found scattered throughout the midden deposit. The pottery is represented by a thick, sherd or clay tempered, brown ware. The vessel form is a deep cylindrical jar having a round flat disc base frequently marked by basketry or matting impressions. The rims are occasionally designed with bold incising which forms simple chevron, diamond or ladder patterns. Chipped objects include an abundance of projectile points, and the most common type has a tapered stem with poorly defined shoulders. Other items are flint knives, spearheads, corner-tanged knives, notched scrapers or bunts, drills, chipped hoes and chipped double-bitted axes. Objects of ground stone include flat pendants and gorgets, atlatl weights and boatstones, celts, grinding stones, mullers, hammerstones, and paint stones of hematite. Bone articles are represented by various types of bone awls, long bone bodkins, fishhooks, atlatl hooks, bone tubes and beads. Shell objects are rare but include beads of various kinds.

The Fourche Maline pottery wares appear to offer an ancestral type for other pottery horizons in eastern Oklahoma and elsewhere. The total archaeological complex contains nothing which suggests influences of the Southern Cult which appears in the Gibson and later horizons. There are many traits which seem to relate Fourche Maline to the early Archaic cultures of the Mississippi Valley. Thus with considerable antiquity suggested by the presence of a crude pottery ware, and with the suggestion that Fourche Maline was partly responsible for later developments within the Caddoan area, it seemed necessary to investigate the nature, validity, and relationships of the complex. This investigation of the Fourche Maline complex

was stimulated considerably by the construction of the Wister Reservoir, a Federal Flood Control Project which happens to lie within the area of all earlier Fourche Maline archaeological investigations.

At the request of the U.S. Army Engineers, a survey of the reservoir was conducted in 1946 by Virginia Drew Watson. At this time, 9 sites were located which had not been noted in earlier investigations. Nineteen additional sites had been known within the area, and it was from partial or complete excavations at these first 19 sites that the Fourche Maline materials were formerly obtained.

Although considerable excavation work had been accomplished within the reservoir, the uncertain and confusing picture presented by Fourche Maline seemed to require additional excavations. Since both time and funds made it essential to examine sites which appeared to offer the greatest amount of information concerning the problem, it was proposed that an intensive survey be conducted within the area. This intensive survey was intended to re-examine all of the sites located by the Watson survey, to dig test pits into the most promising of those examined, and then, from the evidence gained by testing, to select one site which offered the best possibilities for answering the questions concerning the Fourche Maline materials. In this way, it was hoped that excavation at one carefully selected site would greatly clarify the interpretation of earlier Fourche Maline excavations.

The final selection of a single site for excavation was to be governed by the extent to which it could be expected to provide several specific types of information. First, it was necessary to determine whether Fourche Maline represented a single complex or if it were a grouping of several complexes. Since it contained many items normally considered as Archaic, the presence of pottery appeared to require some explanation; hence it was desirable to determine whether or not stratigraphic differences might be represented within the Fourche Maline complex. Second, no house patterns or architectural features were known, and it was hoped that house plans or village patterns might be recovered. Third, the relative position of Fourche Maline materials in relation to other archaeological horizons in the immediate vicinity should be determined. Fourth, what other cultures besides Fourche Maline are to be found within the Wister area?

With these questions in mind, an intensive survey under the direction of Robert E. Bell was conducted in the Wister area during the summer of 1947. During this period three new sites were located making a total of 12 sites that were to be examined. Out of these 12 sites, 4 were selected for test excavations on the basis of surface materials, extent of the occupied area, size of the midden, and proximity to reservoir construction activities. These four sites are the Cantrell site (Lf-4), the Ward site (Lf-10), the Conser site (Lf-3) and the Scott site (Lf-11). Of these only the Scott site yielded data sufficient to warrant intensive excavation.

The Scott site is located in the southern part of Le Flore county in eastern Oklahoma in the Fourche Maline River valley. This region is within the foothills of the Ouachita Mountains which lie to the south. The countryside is rather rugged, featured by high wooded hills and small river valleys. The country has a good supply of wild game and most streams contain several varieties of fish, so that good hunting and fishing are to be had today. Many local people supplement their diet with wild life from the area. In prehistoric times, the Fourche Maline valley must have been an excellent habitation area with a permanent water supply, good timber, and an abundance of fish and wild game. In fact, the Fourche Maline valley does have a great number of archaeological sites along its course. Either the area was thickly populated or it had been occupied over a long period of time. Archaeological materials are to be found almost everywhere within the valley, and most farms have an area of aboriginal occupation representing a camp or village site.

The site lies on the east bank of Fourche Maline River about 2 miles north of Summerfield, SW¼, SE¼, Sec. 3, T5N, R23E, at a place where the Fourche Maline River makes a broad turn toward the south. This curve in the river has been responsible for considerable erosion of the east bank, and some of the original site has been washed away by high waters. The cross-section provided by this exposure, however, gave some idea as to the depth and extent of the deposit; it is a village midden which is almost black in color and hence stands out in contrast to the surrounding grey or brown soils. The midden appears to be concentrated on a slight rise adjacent to the river bank and extends over a circular area about fifty yards across. Artifacts are to be

found outside of this midden area, but the occupational accumulation becomes thinner and thinner as one moves away from the highest portion of the site.

The Fourche Maline valley is subjected to occasional floods and overflows. Mr. Scott stated that the main portion of the site had never been entirely covered by water although the surrounding fields were frequently flooded leaving the midden as a small island.

A few trees, some having a diameter of as much as 15 inches, were growing on the edge of the site close to the river. A strip of land perhaps 10 feet across and parallel with the river separated the cultivated area from the river bank. A comparison of the surface contours within this uncleared strip of land and the adjoining field suggested that little erosion had taken place as a result of plowing. A broad gully has encroached upon the field at the north edge of the site, and occasional artifacts are washed out in this area. It has not caused much damage, however, since the cultural deposit is quite thin in this locality. The initial testing trenches excavated during the 1947 season consisted of eight 5 foot squares arranged in a T-shaped trench. The initial trench was 5 feet wide and 25 feet long, composed of five squares. Since datum readings taken at surface level indicated little variation in contour, excavations were initiated by arbitrary 6 inch levels when measured from the ground surface.

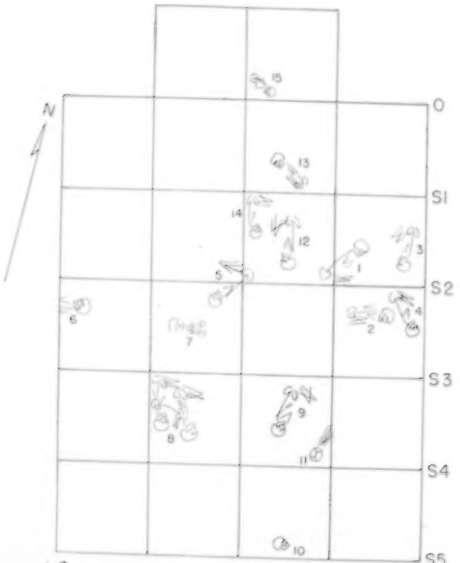

FIG. 93. Excavated area at the Scott site illustrating the position and orientation of the burials.

Upon completion of the initial trench, three squares were dug at a right angle to the R1 row. This permitted a short cross-section of the midden in an east-west direction extending toward the river. Work in this area indicated that the thickest portion of the midden was immediately adjacent to the river bank. These squares were excavated to sub-soil, and, upon completion, the entire trench was refilled with earth. During the 1948 season fifteen squares adjacent to the 1947 trench were completely excavated. Thus during the two periods of digging at the Scott site, an area approximately 20 feet by 30 feet was removed from the main portion of the midden. A single test area, 5 by 10 feet was dug in the nearby field about 75 feet southeast of the midden area. This test revealed a thin layer of cultural debris extending to a depth of 10 inches under the present surface. Apparently a thin veneer of cultural material is to be found in the immediate area surrounding the midden concentration.

Throughout excavation, all objects found were recorded by squares and levels within the square. Each level was removed by small hand picks or trowels by vertical slicing. As each level was completed, the floor and walls were carefully troweled to reveal any structural features that might be present. As squares were completed, profiles were carefully retrowled and examined for stratigraphic differences. Whenever burials were encountered it became necessary to modify this method somewhat until the burial could be isolated, exposed and recorded for removal. Otherwise, the lack of soil differences and natural stratigraphy made excavation dependent upon arbitrary 6 inch levels.

The Scott site midden was disappointing in that it revealed no natural strata superimposed and clearly marked by soil differences. The material composing the midden was quite homogeneous in color and texture of soil, the only noticeable variation being a gradual lightening of the soil color as the depth increased. Immediately upon the surface all profiles presented a dark black humus ranging from 4 inches to 6 inches in thickness. This black humus was underlain by a brown soil which extended from the base of the humus

down to the underlying yellow clay sub-soil. This brown soil is dark colored at the top of the midden but gradually becomes lighter in color as a greater depth is reached, and results in a light brown at the base of the midden. The original surface is clearly marked by an abrupt change in color from the light brown midden soil to a yellow clay sub-soil. Thus the midden appears as a continuous layer of homogeneous material, marked only by slight color changes from top to bottom.

When it became clear that stratigraphic differences were not marked in the profiles, every effort was made to detect anything suggesting occupational surfaces within the midden. No extensive occupational surfaces were found which could be traced over a large area. Occasional concentrations of ash were found which suggested fireplace areas but these were never associated with suspected floors or obvious occupational surfaces. In addition, the ash was not thickly concentrated but rather only more abundant in the brown soil at some localities than others. These areas of ash concentration were small in extent, rarely covering an area more than 5 feet across, and they were likely to occur at almost any level within the site. They were more abundant in the upper levels of the midden than in the lower, although this fact may be a result of variation in weathering and leaching of the lower soils.

The midden deposit ranged in thickness from 5 to 6½ feet with the deepest accumulation close to the river bank. The midden had been built upon a slight natural rise which afforded a good camp location close to the river. The original surface, having been disturbed by numerous rodent burrows, was quite irregular. The midden proper was also marked by considerable rodent activity; many small burrows were clearly marked on cleared floors or profiles.

Throughout excavation of the midden considerable debris was found. This included miscellaneous rocks, fire cracked stones, flint chips, mussel shells, whole and broken animal bones, occasional human bones, small bits of charcoal and various types of artifacts. The only recorded features were burials. The most abundant items were the fire cracked stones, mussel shells, flint chips and animal bones. The burned rocks were scattered throughout the midden although localized concentrations were sometimes present in an area rich in ash or charcoal. Presumably the rocks were associated with a camp fire although nothing approaching a prepared fireplace was evident. An occasional irregular mass of burned clay was found, and this could have represented a hearth, but associated ash, cracked rocks and charcoal were absent. Mussel shells of species to be found in the Fourche Maline River today were abundant in most parts of the midden. Many of these were complete shells, but the majority were broken or crushed. Various types of animal bones were found and were often broken. Almost all of the bones had been subjected to the gnawing of rodents; these tooth marks were quite evident. In addition to the finding of various animal bones, several human bones were found unassociated with burials and scattered throughout the midden. Most of these were small, whole bones, however, and sometimes displayed gnawed areas. Since some of the burials were obviously disturbed by rodent activity, it is suspected that the unassociated human bones are a result of displacement by similar action.

Artifacts or other objects of occupational debris appeared to be more abundant in the upper portions of the midden. Otherwise there was no particular concentration of materials at any special portion of the site. One area produced about as much material as any other, provided the total depth was not too different. Many of the stone objects, especially projectile points, had encrustations of lime on the surface. In most instances, this material is difficult to remove except by applying a weak acid solution. The amount of this lime deposit present upon a specimen appeared to increase in direct proportion to the depth within the midden. Although this may be unimportant, the appearance of such encrusted specimens suggests a reasonable antiquity.

The only non-casual features found throughout the midden were burials. No post holes or pits, other than two caused by "pot hunters," were noted. Two small pit excavations caused by recent souvenir hunters were observed in squares S2L1 and S3L1. Admittedly the dark colored nature of the deposit would make post holes less conspicuous than in lighter soils, especially if they did not penetrate into the underlying yellow subsoil. Nevertheless, when rodent disturbances could be distinguished, one would also expect posthole disturbances to be evident. In spite of careful observation for post holes, pits or other similar features, none were found throughout the excavation. Apparently

architectural features such as houses are absent in spite of the fact that the inhabitants evidently lived upon the midden itself.

The Burials

Throughout excavation of the midden, occasional human burials were found. These were likely to occur at any depth or in any portion of the midden. A total of 15 burials was recovered, 7 during the 1947 season and 8 during the 1948 excavations. The skeletons were generally in poor condition; this was a result partially of poor preservation and partially of rodent activities.

Artifact associations were rare and probably were not intentional burial offerings. In some cases, projectile points would be found in the general burial area. Since the surrounding soils also contained flint chips, broken rocks, charcoal, mussel shells, broken animal bones or other typical midden debris, it is difficult to know if the occasional projectile point found represented an intentional offering or was merely part of the surrounding midden debris. Within any portion of the midden, an area large enough to accommodate a burial would generally produce one or two artifacts, so it is not surprising that some were found near the burials. This difficulty in knowing whether such objects were intentional offerings arises partly from the fact that most burials were not marked by a grave outline. Apparently the body was merely placed upon the ground surface and then covered over with the surrounding midden debris. The burials were not placed into excavated graves but rather merely contributed to the midden deposit as it accumulated throughout occupation of the site (Fig. 93). The absence of a prepared grave appears to be one common feature of the Scott site.

Burial 1 was found 24 inches beneath the surface. The body was in a flexed position, lying on the left side and facing southeast. No grave goods or grave outlines were found. The bones were somewhat disturbed and damaged; for example, the mandible was about 15 inches to the east of the cranium.

Burial 2 was found at a depth of 3 feet 9 inches beneath the surface. The body was in a flexed position, lying on the left side facing the south. The bones were in fair condition and not badly disturbed by rodent activities. A mussel shell was found close to the knee, and a large triangular projectile point was on top of the pelvic area. No evidence of a burial pit or grave outline was present.

Burial 3 was found at a depth of 5 feet. The body was orientated in a north-south direction with the skull to the south and facing the west, in a flexed position and lying on the left side. There were no artifact associations present. The burial was placed directly upon the undisturbed yellow subsoil and covered over with the surrounding midden material. No evidence of a pit or prepared grave was evident.

Burial 4 was at a depth of 5 feet. It was very fragmentary and was represented only by the leg bones, fragments of the skull and small bits of the ribs and pelvis, all in poor condition. The body had been placed immediately upon the yellow subsoil in a flexed position. The burial was lying on the right side with the head toward the southeast. No artifacts or grave features were in association.

Burial 5 was found at a depth of 5 feet. It was in a semi-flexed position with the knees extending outward at a right angle to the body. The burial was orientated in a northeast-southwest direction with the skull toward the southwest, on the left side and facing the northwest. The bones were in poor condition and were partly disturbed; some bones were displaced or destroyed by rodent action. No artifacts were found in association. The burial had been placed upon the original surface as marked by the yellow subsoil.

Burial 6 was at a depth of 62 inches. The skeleton extended westward into the unexcavated portion of the site and so was not removed. The bones recovered were the skull, arm bones, several vertebrae and miscellaneous fragments of the hands and shoulder structures. Judging from that portion of the body present, the burial was flexed, lying on the right side with the body in an east-west direction. The skull was toward the east and facing north. No artifacts were found in burial association. The body was not marked by a grave outline and had been placed from three to four inches above the original subsoil surface.

Burial 7 was found at a depth of sixty inches, in a shallow oval-shaped basin which had been scooped out of the yellow subsoil. This basin was three inches deep with a length of twenty-four inches and a width of sixteen inches. The body had been tightly flexed to occupy a very small area; it was placed upon the back with the legs and arms folded tightly upon the chest. No grave offerings were found. Although the bones were in articulation, the skeleton was incomplete and was partly disturbed by rodent burrows.

Burial 8, a multiple grave, was found at a depth of 31 inches. Three individuals, 2 adults and one small child, were represented in the burial. Both adults were in a semi-flexed position, lying on the right side and facing the east. The body axes extended north and south with the skulls to the south. The skeletons were close together and obviously were buried at the same time. The third skeleton, that of a child, lay across the chest region of the two adults with the skull toward the northwest and the body axis arranged in a general

northwest-southeast direction. The child's body was also in a semi-flexed position and apparently was buried at the same time, having been placed on top of the other two individuals. Most of the bones were in an articulated position although some were displaced or disturbed by rodent action. No evidence of a grave outline could be seen and typical midden materials surrounded the skeletons. One adult individual held a flint chip in his mouth, and two projectile points were found in the grave area. Although some bones were missing, what remained were in a good state of preservation.

Burial 9 represents a single adult individual found at a depth of 51 inches, on the right side in a semi-flexed position. The burial axis was in a general north-south direction with the head toward the south and facing southeast. Although the bones were in fair condition, some of the smaller ones were misplaced or missing. No grave outlines could be observed and no artifacts were found in association with the skeleton.

Burial 10 is represented only by the skull of a young individual, found at a depth of 41 inches. The skull was in poor condition; no other bones were found. The skull was facing in a north-east direction, and since it appeared just seven inches north of the south wall, possibly the remaining portions of the skeleton are to be found in the unexcavated square to the south. No artifact associations or grave outlines were found.

Burial 11 is a bundle burial found at a depth of 63 inches. The skeleton is incomplete and composed primarily of the long bones of the arms and legs, plus the skull. The long bones had been placed in a small pile, roughly parallel to one another, with the skull sitting at one end. The bones were not in articulation and certainly represent a secondary burial. The skull sat upon the foramen magnum facing the northwest. No artifacts were found in association, and no grave outlines could be seen. The burial had been placed upon the original surface underlying the midden deposit.

Burial 12 was found at a depth of 63 inches. It represents a single individual; the remains were in a very poor condition and were placed in a fully flexed position upon the original surface underlying the midden. The skeleton was arranged in a north-south direction with the skull toward the south and facing west. The bones had been partly disturbed by rodent activities, and the skeleton was incomplete but in articulation. No burial associations were found.

Burial 13, found at a depth of 42 inches, represents a single individual. The skeleton was tightly flexed, lying on the right side in a general north-west south-east direction. The bones were in very poor condition and the skeleton was incomplete. No burial goods were found in association with the skeleton.

Burial 14 is a young individual; the bones were in very poor condition. This burial was found at a depth of 62 inches, in a semi-flexed position on the right side and orientated in a north-south direction with the skull to the south. The body had been placed upon the yellow subsoil and had been covered over with midden material. A crude bone awl was found underneath the pelvis when the burial was removed.

TABLE 13. BURIALS FROM THE SCOTT SITE*

Burial number	*Condition*	*Sex*	*Age*	*Number of individuals*	*Type of burial*	*Depth from surface*	*Body orientation*	*Direction of skull*	*Disturbances*	*Associations*	*Remarks*
1	poor	Female	21-25	1	flexed	28"	NE-SW	NE	yes	none	
2	fair	Female	21-25	1	flexed	45"	E-W	E	yes	1 shell, 1 point	
3	poor	Female	15-18	1	flexed	60"	N-S	S	yes	none	on subsoil
4	very poor	Male	12-15	1	flexed	62"	NW-SE	SE	yes	none	on subsoil
5	poor	Female	22-27	1	semi-flexed	60"	NE-SW	SW	yes	none	on subsoil
6	fair	Male	19-20	1	flexed?	62"	E-W	E	?	none	
7	poor	Female?	11	1	flexed	60"	E-W	W	yes	none	shallow pit
8	good			3	semi-flexed	31"	N-S	S	yes	2 points	
(a)		Male	30-35								
(b)		Male	27-30								
(c)		?	-5								
9	fair	Female	35-40	1	semi-flexed	51"	N-S	S	yes	none	
10	poor	?	-5	1	?	44"	?	?	?	none	
11	fair	Female	25-28	1	bundle	63"	-	-	?	none	on subsoil
12	very poor	Female	27-30	1	flexed	63"	N-S	S	yes	none	on subsoil
13	very poor	Male?	7-12	1	flexed	42"	NW-SE	NW	yes	none	
14	very poor	Male?	11?	1	semi-flexed	62"	N-S	S	yes	bone awl	on subsoil
15	very poor	?	-10mo.	1	semi-flexed?	56"	NW-SE	SE	yes	none	

*Age and sex determinations done by H. D. Brighton.

Burial 15 was a young child. It was found at a depth of 56 inches. The bones were in poor condition and were considerably disturbed by rodent activities; the legs were entirely missing. Presumably the burial was originally in a semi-flexed position; it was placed on the left side and was orientated in a northwest-southeast direction with the skull toward the southeast. No artifacts were found with the burial, and no grave outlines could be seen. Some broken animal bones were scattered through the burial area, but they appeared to be associated with the rodent burrows.

The Scott site burials are typically single interments placed in a semi-flexed position without consistent body orientation; they lack grave offerings. No specially prepared graves are evident; the burials were merely placed upon the ground and covered over with earth and midden debris. Multiple burials and bundle burials are represented by single examples. Grave associations are uncommon and may or may not be intentional offerings. In either case, associations are simple and are normally represented by projectile points or some single object. There does not seem to be any consistent orientation of the burials, and they are found at various levels within the midden. Most burials recovered were in poor condition and were disturbed by rodent activities.

Artifacts

Artifacts from the Scott site include articles made of chipped stone, ground stone, bone, antler, shell and pottery. They were found scattered through the midden, and were about equally distributed throughout the various squares. A larger number of specimens were found in the upper levels although artifacts were present in all parts of the midden.

	Material Total sample								Shape Types													
	Total sample	Suitable for shape typing	Too broken	Quartzite	Black Flint	Novaculite	Peoria Flint	Misc.	1	2	3 A	3 B	3 C	4	5	6	7	8	9	10	11	12
Test pit	15	9	6	8	1	1		5			3	4	1									1
Surface	65	42	23	30	8	1		26	1		5	14	6		1				1	7	3	4
Midden Level 1	95	40	55	33	19	2		41			1	12	7	5	5	1	1			3	3	2
Level 2	13	6	7	7	1			5			1	3	2									
Level 3	17	11	6	2	3			12			1	2	2	1					1	3	1	
Level 4	37	22	15	10	7	2		18			2	8	6	1	1				2		2	
Level 5	41	20	21	17	5	1		18			3	7	6					1		3		
Level 6	35	14	21	13	2	1	1	18				3	4					1	1	4		1
Level 7	26	17	9	11	2	1		12			6	4	4						1	1		1
Level 8	25	12	13	6	7			12			4	1	3							3		1
Level 9	26	14	12	8	8		1	9	1	2	2	1	2									6
Level 10	13	4	9	5	4			4											3	1		
Level 11	7	1	6	2	1			4	1													
Level 12	4		4	1				3														
TOTALS	409	212	207	153	68	9	2	187	3	2	28	59	43	7	7	1	1	2	4	29	8	18
PERCENTAGE		50.7	49.3	36.4	16.2	2.1	.5	44.8	1.4	.9	13.2	27.8	20.3	3.3	3.3	.5	.5	.9	1.9	13.7	3.8	8.5

Fig. 94. Scott site projectile points.

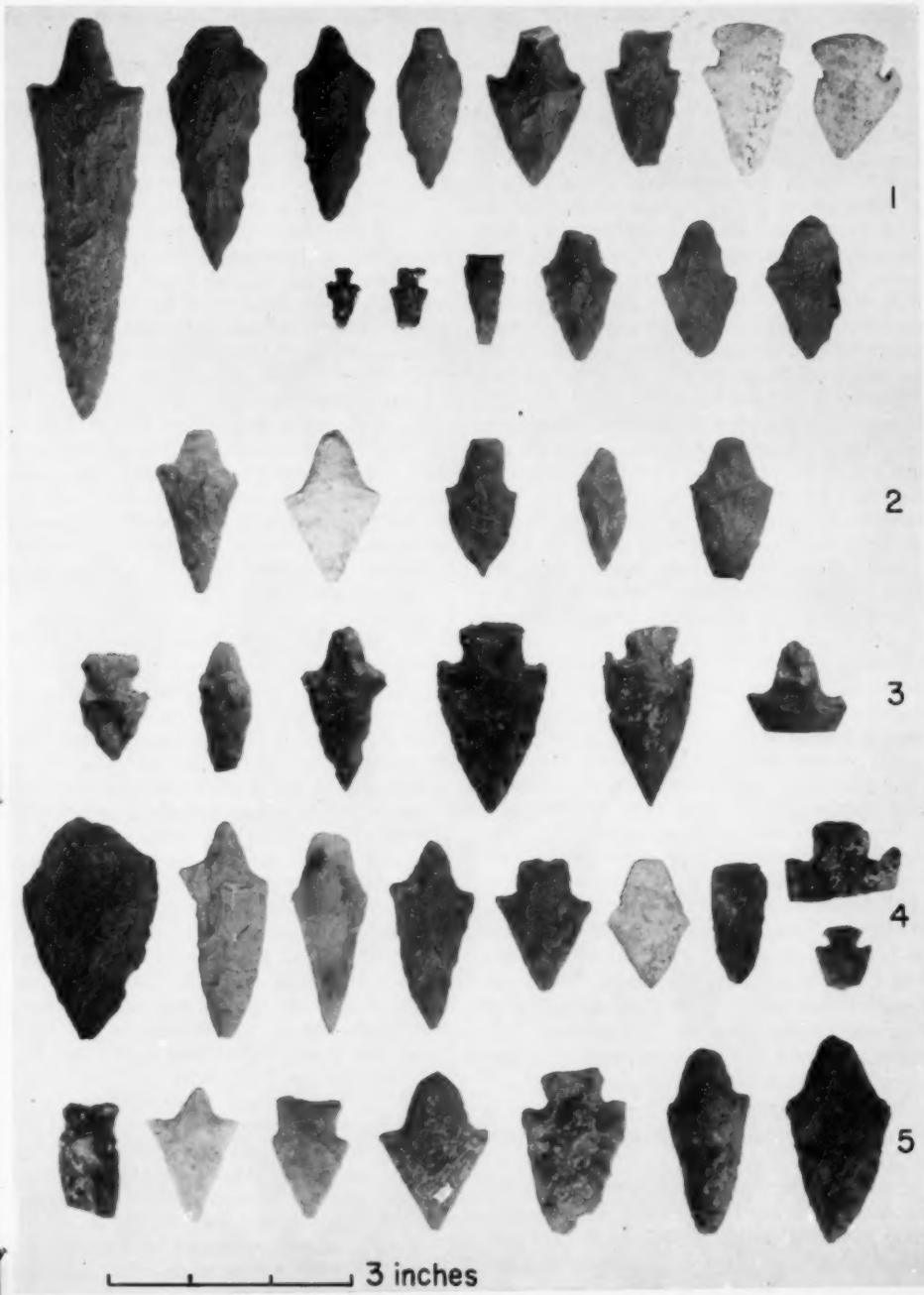

FIG. 95. Projectile points from levels 1 through 5 at the Scott site.

Objects of chipped stone include projectile points, drills, knives, scrapers, double-bitted axes, crude unfinished objects and miscellaneous unclassified materials.

All flint flakes recovered were saved for a detailed study of the material and for the possible stratigraphic differences which may be reflected in the chipping debris. A total sample of 5,590 pieces of flint were examined for the type of material and the relative quantities from each square and level. Very little material could be identified as to the quarry source. Five flakes are of novaculite derived from the well-known quarries near Hot Springs, Arkansas (Holmes, 1919, pp. 196-200), and two flakes are similar to the Peoria flint from northeastern Oklahoma (Holmes, 1919, pp. 201-209). The balance of the chipped debris has been grouped into three categories: quartzite, black flint and miscellaneous. The quartzite and black flint together comprise over one-half of the total sample. The materials are so common and uniform in character that they are probably derived from local quarries which have not been located or identified. The remaining flint chips include a great variety of materials, none of which could be identified as to its original source. Many of these flakes exhibited the weathered cortex so characteristic of flint nodules and were presumably derived from various gravels to be found in the area.

All identifiable materials were examined from the standpoint of percentages present in each of the various levels, and no significant differences could be seen throughout the site. Apparently the supply of flint materials remained quite constant throughout occupation of the area. The number of chips was greatest in the first level, but they were also abundant in levels 4, 5, and 6; the remaining levels had a smaller quantity represented. There was a gradual decrease in the flint debris from level 7 down to the base of the midden. The significance of a greater concentration of flint chips in levels 4, 5, and 6 is not understood, although it may represent a period of more extensive occupation or slower accumulation of midden debris.

The most common artifact of chipped stone represented at the Scott site is the projectile point. A total sample of 419 specimens were found, about one-half of which were so damaged that the original form or shape type could not be determined. The specimens were distributed throughout the midden, the test pit, and the surface.

All of the projectile points were examined for the type of material. The greatest number were made of quartzite; this group comprised 36.4 percent of the total. Black flint was also common and ranked second in abundance. Nine specimens were made of novaculite from the Arkansas quarries, and two specimens appear to have been made from Peoria, Oklahoma flint. It is interesting to note that finished artifacts of novaculite and Peoria flint are more abundant than chips or flakes of these materials. The remaining specimens represent a great variety of flint ranging through all colors and textures and presumably representing various minor sources of supply.

All projectile points from various levels in the midden were examined for any variation that might suggest stratigraphic differences within the site. A summary chart of projectile point data is presented in Figure 94. Examples of points representing the various levels are presented in Figures 95 and 96, and examples of the classified shape types are presented in Figure 97.

The entire sample of projectile points which were whole enough to permit determination of the original form were examined for characteristics. which might reflect stratigraphic differences in the midden. The most typical Scott site projectile point is made of quartzite, is large in size, rather crude in workmanship and is represented by shape type 3b (Figs. 94, 97). The few obvious differences were those in shape types and size. In general, the Scott site points are crudely made, probably because of the material; occasionally, however, good quality workmanship is found in all levels of the midden. Small sized points such as those represented by shape types 4, 5, 6 and 7 are limited to the upper levels and are most common in the top six inches. All of the other points vary in size; the average is between two and two and one-half inches in length, and points of this size occur scattered through all sections of the midden. There is a general impression that the tapered stemmed forms grouped under shape type 3 become less broad and less irregular in outline as one progresses from lower to upper levels. A more detailed study such as that suggested by Baerreis and Hornseth (1948) may be useful in determining time differences in these generalized types. Shape types 1 and 2 are limited to the lower

FIG. 96. Projectile points from levels 6 through 11 at the Scott site.

levels, and shape types 4, 5, 6 and 7 are limited to the upper levels. The remaining shape types are fairly well scattered throughout the site and may or may not be useful for chronological differences.

Two examples of flint drills or perforators were found. One is broken and is represented merely by a section of the point; the other is complete but is crudely made from a flake which has been trimmed to a tapering pointed drill. Both examples are from the central section of the midden.

Flint scrapers have been grouped into three varieties: hafted scrapers, flake scrapers and core scrapers. A combined sample of 40 specimens was found. One hafted scraper was found in the eleventh level of the midden. It is carefully made but is a unique specimen from the site. The flake scrapers are most common and appear to be most abundant in the lower levels of the midden. These are made from random flakes which are secondarily chipped along one or two sides to produce a scraping edge which in most cases exhibits some signs of use. Examples of flake scrapers are shown in Figure 98.

A total of 15 small oval shaped core scrapers was found. These are crude, flaked on both sides and average about two inches in length. They resemble a turtleback core or unfinished object, but several have smoothed edges indicating their use as a scraper.

The Scott site knife is typically a small oval shaped blade between three and four inches in length and is rather crudely made. Examples of knives are shown in Figure 98. Most of the examples found were broken, crudely chipped of quartzite and were from various levels of the midden.

There is a group of crudely chipped and irregular shaped objects from the Scott site which are here regarded as unfinished artifacts. These are of varying sizes, chiefly made of quartzite, and resemble the quarry blocks so common at flint quarries. They are apparently unfinished objects or were discarded cores no longer considered useful. These appear in nearly all parts of the midden.

A single chipped double-bitted axe was found in level 5 of the midden. This is illustrated in Figure 98. The central portion between the notches is rubbed and slightly polished, presumably from hafting.

The large flaked object illustrated in Figure 98 is designated as a digging tool or stemmed hoe. Although broken, the broad end exhibits some of the use polish so characteristic of flint digging tools. This single specimen was found in level 8 of the midden.

A small variety of pecked and ground stone objects was found at the site. These include gorgets, boatstones, celts, rubbed pieces of hematite, grinding stones, hammerstones, cup stones and rubbing stones. A summary tabulation of the various levels represented by ground stone objects is given in Figure 100.

Four fragments of polished stone gorgets or pendants were found in the midden. The largest fragment is illustrated in Figure 99. It apparently represents a large oval shaped gorget with two perforations. The edges of all specimens have been beveled to a wedge shaped cross-section. All examples are made of grey slate and may or may not represent the same type of gorget.

Two small pieces of boatstones were found. One is a mid-section fragment and it is impossible to determine the original form. The second specimen is characterized by a notch at the end. Both specimens represent boatstone types which have been carefully hollowed out on the inside.

A single broken celt was found in level 1 at the site. It is made of quartzite and was chipped into shape and then partly ground to

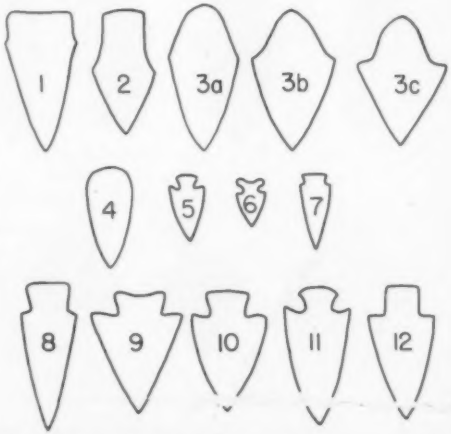

FIG. 97. Examples of projectile point shape types used in classifying the Scott site series.

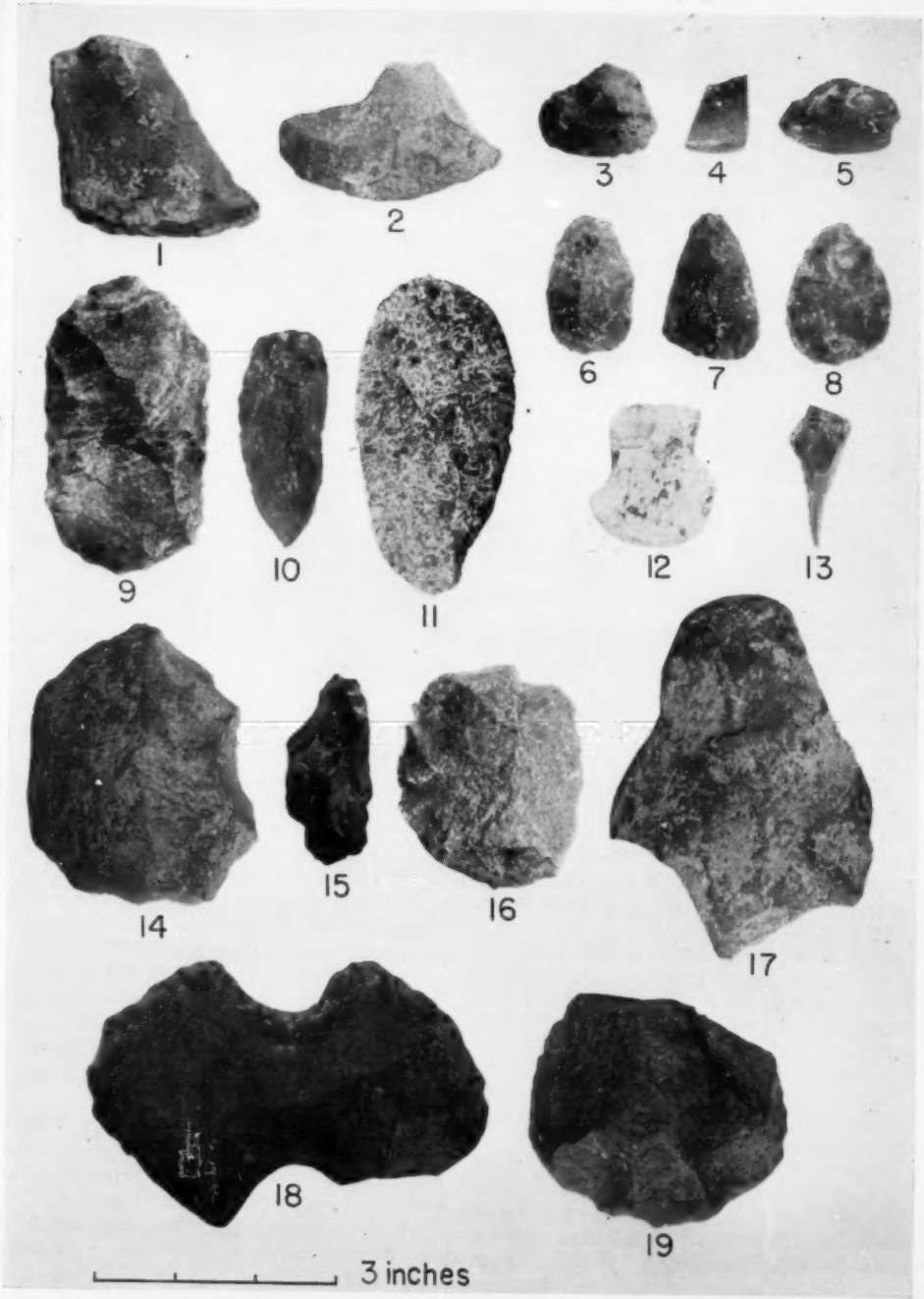

FIG. 98. Stone objects from the Scott site. *1-5*, flake scrapers; 6-8, core scrapers; *9-11*, knives; *12*, hafted scraper; *13*, drill; *14-16*, unfinished objects; *17*, digging tool (bit broken); *18*, double bitted axe; *19*, chipped stone celt.

produce a more effective cutting edge. It is illustrated in Figure 98.

Five small irregular lumps of hematite were found. Each specimen has rubbed surfaces present which were presumably produced by powdering the hematite for red paint. These were apparently paint stones and not intentionally made artifacts.

Thirteen grinding stones were found throughout the midden. Some of these were fairly well shaped into an oval hand stone for grinding on a relatively flat surface. Others were rather roughly shaped except for the grinding surface. Whether these were used for grinding corn or for wild seeds cannot be determined; either could be the case. At any rate, they are rather similar to manos or grinding stones found on known agricultural sites throughout the state.

Small globular pecking hammers are represented by 6 specimens. These are round or oval shaped rocks with abrasions produced from pounding or pecking other materials. With the abundance of rocks in the midden it is surprising that so few hammerstones were found.

Two small cup or pitted stones were found in lower levels at the Scott site. Each specimen is an unprepared stone having two flat sides into which a small cup or pit has been pecked. Their use remains questionable.

Three stones having flat rubbed surfaces were found. These do not appear to have been used for the same purpose as the grinding stones. The stone is unmodified except for a rubbed area on one or two sides presumably produced by grinding on another surface. The rubbed surfaces suggest their use as a hone rather than as a milling stone.

Objects of bone or antler include bone awls or perforators, antler tip projectile points, bone projectile points, bone pins or bodkins, a bone engraving tool, perforated teeth and other miscellaneous pieces of worked bone. A total of 38 such specimens were found throughout the site. Figure 100 indicates the various levels represented by the series of bone or antler artifacts.

Bone awls are represented by 15 specimens, most of which are broken. The single complete specimen is 5¼ inches long, and all fragments suggest awls which would be of a similar or smaller size. They are generally made from bone splinters or split sections of bone, and four are made from the shaft section of bird bones. With a single exception, the awls are crudely made; the bone was left rather rough and unfinished except for grinding one end down to a tapered point. Examples of awls are shown in Figure 99.

Antler tips are represented by 11 specimens. Nine of them are presumably projectile points since the base has been hollowed out to receive a shaft. Two specimens lack the basal socket and have blunted points. These were apparently used for some other purpose, probably as a flaker in working flint.

Three pointed bone splinters have been classified as projectile points because of their similarity to those described by Webb and De Jarnette (1942) for the Lauderdale focus. These are illustrated in Figure 99. Although the points appear to be crude and battered, the possibility remains that they represent poorly made or unfinished awls.

Bone pins or bodkins are indicated by 2 fragments. Both specimens are round pencil-like bone objects which have been well polished and skillfully made. One specimen includes the base which flares to a circular pin type head. Both the pin-head base and the base of the shaft have notches or cut marks for a design. The second fragment represents the point end of a broken bodkin which has a purposely blunted point.

Miscellaneous bone items include those shown in Figure 99. One is a small pointed bone tool, presumably an engraving or fine perforating instrument. It appears to have been made from a larger bone specimen which was broken and then reworked. A single perforated canine tooth was found. It has a small hole for suspension at the base of the root and represents some small carnivor, probably a dog or a coyote. Three flat, tabular worked pieces of bone were found. One seems to represent a bone blank for the manufacture of a fish hook; one end has been gouged out on each side and is similar to specimens illustrating the process in bone fish hook manufacture. The remaining 2 specimens may represent flat spatulas or some similar bone object.

The only worked shell specimens are 2 shell spoons or scrapers made from one-half of a river mussel. Both specimens show grinding and wear from use or abrasion, along the edges. Since many whole shells were found throughout the midden, many other shells may have functioned as spoons; however, these two are the only ones with definite evidence of wear or utilization.

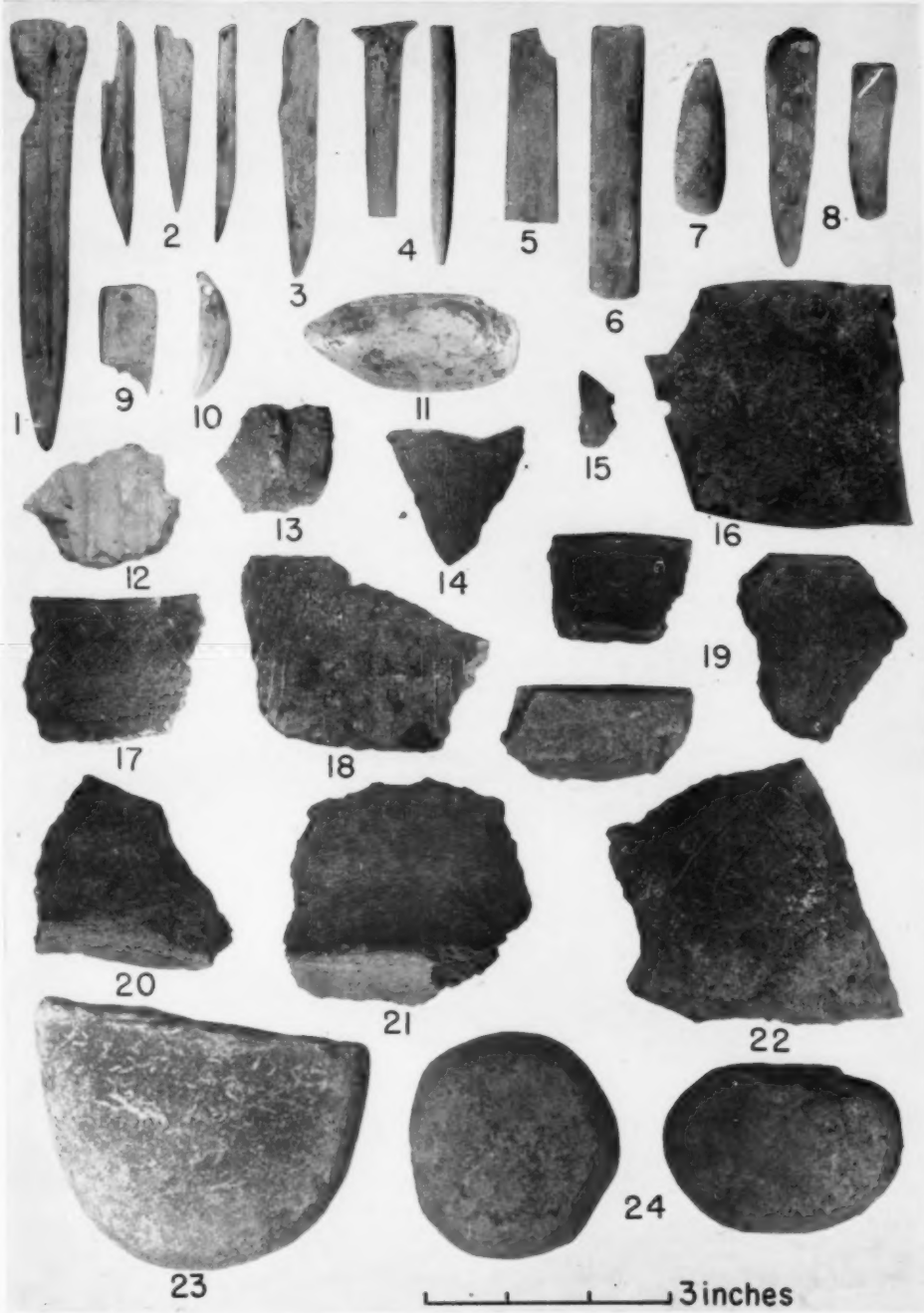

FIG. 99. Artifacts from the Scott site. *1, 2,* bone awls; *3,* bone projectile point; *4,* portions of bone bodkins; *5-7,* flat pieces of worked bone; *8,* antler tips; *9,* bone engraving tool; *10,* perforated tooth; *11,* shell scraper; *12,* clay with stick impressions; *13,* shell tempered sherd; *14* and *15,* decorated pottery sherds; *16,* broken stone gorget; *17-19,* clay tempered rim sherds; *20, 21,* clay tempered base sherds; *22,* decorated body sherd; *23,* grinding stone; *24,* hammerstones.

Pottery

A total sample of 319 pottery sherds was recovered during the excavations. Most of these represented two main types of pottery: a granular clay tempered ware and a shell tempered ware. The balance of the sherds are unclassified specimens or are distinctly different from the two main wares. No complete or restorable vessel was recovered.

The majority of pottery sherds are a thick granular clay tempered ware. A total of 266 sherds represent this type of pottery. The distribution according to levels is as follows:

Level 1	68
Level 2	54
Level 3	62
Level 4	37
Level 5	13
Level 6	24
Level 7	5
Level 8	2
Level 9	1
Total:	266

The sherds are of varying size ranging from pieces about 1 cm. square up to sherds 12 cm. across. Most sherds average between 3 cm. and 5 cm. in diameter. It is impossible to tell how many complete vessels are represented although rim sherds indicate a minimum of 10 vessels. Many body sherds are obviously from the same vessel, but it is impossible to restore the vessel represented.

It can be noted that most specimens are limited to the upper six levels of the site. Although 8 sherds were found in lower levels, they came from squares which had disturbances from roots or pot-hunting activities and probably originated at higher levels. At any rate, the occurrence of sherds under the sixth level appears to be relatively unimportant.

Paste.

Method of Manufacture: some of the thicker sherds show coil breaks although examples are rare. A few sherds have a malleated surface suggesting a paddle and anvil treatment.

	Chipped Stone								Ground Stone								Antler and Bone							
		Scrapers																						
	Drills	Stemmed	Flake	Core	Knives	Unfinished Objects	Flaked Axe	Digging Tool	Gorgets	Bonestones	Celts	Hematite	Grinding Stones	Hammerstones	Cup Stones	Rubbing Stones	Bone Awls	Antler Tips	Projectile Points	Bodkins	Engraver	Perf. Tooth	Scrapers (Awls)	Flat Pieces
SURFACE			1	5	6	9								1				1						
MIDDEN																								
Level 1			2	2	2	3					1		2				2							
Level 2			1		1	2			1	1			5					1		1				
Level 3				1		1			1	1		1	2	2			3	1		1				
Level 4				1	1	1			1			1	3	1		2	2	1						
Level 5			2	1	2		1										1				1		2	
Level 6	1		1		2	2			1	1		2	1	1			1					1	1	
Level 7	1		2	2	3	2						1			1	1	2	2	1					
Level 8			1			3		1						1			3	2					1	
Level 9			3	3	4	2									1				1					
Level 10			1														1	2						1
Level 11		1	8		1													1	1					
Level 12			2																					
TOTALS	2	1	24	15	24	28	1	1	4	2	1	5	13	6	2	3	15	11	3	2	1	1	2	3

Fig. 100. Scott site artifacts.

Tempering: the sherds are tempered with granular pieces of unpulverized clay. These irregular grains of tempering material are commonly 2 mm. or 3 mm. in diameter although their size is proportionate to the sherd thickness. In some thick sherds, grains as large as 5 mm. are common, whereas in the thinner sherds, more care has been taken to crush the granules. In addition to the clay tempering, an occasional grain of coarse sand will be found.

Texture: the paste is poorly mixed so that the sherds break with irregular fractures and are likely to crumble. The firing has been poorly controlled so that most sherds have a bi-colored paste, being dark and reduced on the interior and oxidized on the outside. In the thinner sherds the firing is likely to have been more successful.

Hardness: 2.0 to 3.5 with an average around 3.

Color: gray, light tan, to dark brown.

SURFACE FINISH.

The surface is smooth on both exterior and interior. Tool marks of a smoothing tool are common on most sherds and are indicated by faint parallel striations on the vessel surface. The smoothing marks are most common on the outside of the vessel.

DECORATION.

The only decoration is crude incising occurring in roughly parallel lines and chevron or cross-hatch designs; these are apparently limited to the rim of the vessel. The incisions are crudely executed and appear to have been made with the rough end of a broken stick. The incisions were made when the clay was soft and no attempt was made to smooth the clay forced aside by the incising implement.

FORM.

Lip: the lip of the vessels is commonly rounded although sometimes it has been flattened. In cases where the lip has been flattened, it has a slight flare on the exterior of the vessel.

Rim: the rim is simple and usually tapers slightly in thickness becoming thinner toward the lip. On one specimen the rim has an exterior bevel which delimits the upper one inch of the rim from the body of the vessel. Most sherds have a straight rim although one specimen indicates that flared rims do occur.

Body: the sherds are not large enough to determine the vessel shape although a deep bowl or "flower pot" form is suggested by base sherds.

Base: the base sherds indicate a thick, round disc base with a flattened bottom. A single sherd apparently is marked with a basketry impression on the base.

Thickness: 6 mm. to 33 mm. Average between 10 mm. and 12 mm.

Vessel Size: the curvature of body, rim and base sherds suggests large vessels. One base sherd, for example, indicates a minimum basal diameter of 18 cm.

Appendages: none present.

REMARKS.

This ware is similar to the thick clay tempered ware listed as Type No. 1 at the Spiro site in eastern Oklahoma by Orr (1946). It appears to be a common utility ware rather widely distributed throughout eastern Oklahoma.

A small portion of the pottery sherds were shell tempered, a characteristic which clearly separated them from the other specimens. A total of thirty-two of these was found; all were within the four top six inch levels of the site. The distribution of the shell tempered sherds is as follows:

Level 1	19
Level 2	7
Level 3	5
Level 4	1
Total	32

The sherds are of varying sizes and range from fragments about 2 cm. square up to fragments 8 cm. to 10 cm. across. Sherds which had been broken in excavation or which could be fitted together were restored and counted as a single specimen. Some sherds are obviously pieces of the same pottery vessel even though the pieces cannot be fitted together. Judging from differences in the sherds, a minimum of five pottery vessels is represented by the sample.

PASTE.

Method of Manufacture: several thick sherds exhibit coil breaks, and two specimens indicate that each flattened coil of clay was between 4 cm. and 5 cm. in width.

Tempering: crushed mussel shell. In most sherds the shell has not been finely crushed and fragments measuring between 2 mm. and 3 mm. are common. In many sherds the shell tempering is not apparent without a fresh fracture since the exposed pieces of shell have been leached away. Some of the thinner sherds have most of the shell leached away so that they are quite light in weight and porous in texture.

Texture: the clay is lumpy and poorly kneaded so that the tempering materials are unevenly distributed throughout the paste. The sherds break with irregular fractures except along coil lines. The shell fragments may or may not be orientated to the plane of the vessel wall.

Hardness: 2 to 3 with an average around 2.5.

Color: gray, tan, light brown to dark brown.

SURFACE FINISH.

The exterior and interior surfaces have been smoothed but are lumpy and irregular. Marks from a smoothing tool are sometimes present. The surfaces usually have many small holes as a result of leaching.

DECORATION.

A single sherd has a short fillet of clay attached to the outside surface. This added strip of clay appears to have some stab marks upon its surface.

FORM.

Lip: rounded or slightly flattened. The lip is not carefully finished and is likely to be irregular and unsmoothed on the interior of the vessel.

Rim: simple rim which may taper in thickness becoming thinner at the lip. Straight or recurved and flaring.

Body: one sherd indicates a globular jar with rounded shoulder, slightly constricted neck and flared rim.

Base: one flat sherd suggests a flattened base.

Thickness: 5 mm. to 11 mm.
Vessel Size: one only can be estimated; it has a diameter of at least 30 cm. and a minimum height of 18 cm.

Appendages: none present.

REMARKS.

Most of these sherds are similar to what would be considered as typical Middle Mississippi shell tempered pottery.

There are 21 sherds which do not seem to belong in the shell or clay tempered wares mentioned above. Five specimens have a small amount of bone tempering, one has been tempered with sand, and the others are predominantly fine clay or other material. Their distribution according to levels is as follows:

	Bone	*Sand*	*Misc.*
Level 1	3		5
Level 2			5
Level 3		1	2
Level 4	2		1
Level 5			2

It is worthwhile now to determine whether the excavations produced answers to several questions posed before the work was undertaken. One of these was whether the materials considered as Fourche Maline represented a single complex or if Fourche Maline were a mixture of several complexes. The association of pottery with traits that are generally considered as Archaic suggests that an Archaic and early Woodland horizon were mixed together under the term Fourche Maline. From the stratigraphic distribution of the artifacts, it is clear that the pottery sherds are concentrated in the upper levels of the site. Of the two major wares represented, the granular clay tempered ware is found in the top six levels and the shell tempered ware is upon the surface or within the top two levels. In the lower levels, pottery is absent and apparently not a part of the artifact complex. Thus it appears that the Scott site has represented a prepottery or non-pottery horizon followed by an occupation characterized by a granular clay tempered pottery overlain by a shell tempered pottery accumulation. Aside from the projectile points, the small amount of other artifacts recovered is probably not adequate to reflect stratigraphic differences. Within the projectile points, however, types 1 and 2 are found in the lower non-pottery levels, while the smaller points, represented by types 4, 5, 6 and 7, occur in the top levels and are probably to be associated with the shell tempered pottery. The remainder of the specimens do not seem to be limited to any special level within the midden. Thus it does appear that the site has upper levels containing pottery superimposed upon those where it is absent. Of the two pottery wares present, the shell tempered wares are apparently more recent. This is in agreement with the general supposition that the Fulton aspect (shell tempered wares) follows the Gibson aspect (granular clay tempered wares) throughout eastern Oklahoma.

From excavations at the Scott site it is still not possible to delimit the cultural characteristics of the non-pottery horizon from the pottery bearing horizon. The remaining artifacts recovered, with the exception of the projectile point shape types mentioned above, appear to be scattered through the midden with apparent disregard to the pottery distribution.

This situation is further complicated by the fact that some traits usually considered as a part of the Fourche Maline complex are not found at the Scott site. Some of these traits are dog burials, corner tanged knives, bannerstone atlatl weights, stone axes, stone beads, bone atlatl hooks, bone tubes, bone beads and shell beads. It is quite possible, of course, that additional excavations might produce some of these objects; nevertheless, they are either very rare or are a part of the complex not represented at the Scott site.

All efforts to locate evidence of house structures within the Scott site or other Fourche Maline sites examined were in vain. An occasional post hole was found but nothing which would suggest a house or architectural feature for living quarters was located.

The stratigraphic position of Fourche Maline certainly appears to underlie all other archaeological materials in the area where it was examined. A comparison of the pottery wares and the general artifact complex indicates that it is older than both the Gibson and Fulton aspects which occur in eastern Oklahoma.

It is also clear from the survey that other cultures besides Fourche Maline are present in the Wister area. Specimens which represent both the Gibson and Fulton aspects are to be found at some known sites.

Excavations at the Scott site suggest that the Fourche Maline focus as it has been recognized is either not a single complex or that it existed with some modifications over a long period of time from an Archaic prepottery period through early Woodland, and possibly longer. At the present time, it is not possible to clearly differentiate time or cultural differences because of inadequate data. With a detailed comparative analysis of individual Fourche Maline sites, a clearer picture will become available.

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Norman, Oklahoma
October, 1952

ASSOCIATION OF ARTIFACTS WITH MAMMOTH IN THE VALLEY OF MEXICO[1]

LUIS AVELEYRA ARROYO DE ANDA AND
MANUEL MALDONADO-KOERDELL

IN THE PAST 30 years discoveries of great importance in the prehistory of Mexico have been made in the vicinity of Tepexpan, a town some 35 kms. northeast of Mexico City. Diaz Lozano (1922-23, 1927) disinterred a mammoth identified as *Mammuthus* (*Archidiskodon*) *imperator* Leidy, which is now seen partially mounted in the entrance hall of the Instituto Geologico de Mexico. Mullerried (1933, 1934) collected teeth and bones of the ground sloth *Mylodon harlani* Owen on lands of the Colonia Estrella on the northern side of Mexico City near the old exit road to Pachuca, which continues on to Tepexpan and Teotihuacan. Both Diaz Lozano and Mullerried simply described the sequence of strata at the fossil localities, mentioning the nature and depth of the deposits, but without applying specific names to the formations.

The modern concepts of upper Pleistocene and Recent stratigraphy in the Valley of Mexico began to develop with the work of Arellano (1946a) and Bryan (1946), who established the stratigraphy and terminology now used: *e.g.*, the lower and upper formations of the upper Pleistocene (Tacubaya and Becerra, respectively) are separated by Caliche I; the lower and upper portions of the Becerra are sometimes separated by Caliche II; and the Becerra itself is sometimes found overlaid with Caliche III, the Totolzingo "earth," and other Recent deposits. Arellano (1951) has described the lacustrine, alluvial, and aeolian facies of the Becerra, and the corresponding details of the Totolzingo "earth."

Beginning in 1945, Helmut de Terra, under the auspices of the Viking Fund, Inc. (now the Wenner-Gren Foundation for Anthropological Research), conducted analysis of physiographic, geologic, and stratigraphic conditions in the Valley of Mexico, particularly evidences of glaciation in connection with the volcano Iztaccihuatl, and the geohydrology or fluctuations in the extent and volume of Lake Texcoco. De Terra's work culminated in the discovery of a fossil human skeleton under the lakebed surface near Tepexpan in 1947. Previously, indications of ancient cultural remains in this vicinity were described by Arellano (1946b, 1946c) who collected a worked obsidian flake near a mammoth skeleton under somewhat doubtful stratigraphic conditions. Other finds of de Terra (1946) consist of artifacts of bone, flint, and obsidian from various localities in the Valley of Mexico, which gave him the basis for establishing two preceramic levels: the San Juan "industry" corresponding to the Becerra formation, and the Chalco "complex" corresponding to the Totolzingo "earth." The second survived into Recent times. Thus de Terra synthesized prehistoric materials which until then had only been described in incoherent form.

Maldonado-Koerdell and Aveleyra Arroyo de Anda (1949) reported other discoveries at the Tequixquiac locality 60 kms. north of Mexico City, a locality well known to geologists and paleontologists for the richness of its upper Pleistocene fossils. At the beginning of 1952, through the combined efforts of Caso and Marquina, the Direccion de Prehistoria was formed under the Instituto Nacional de Antropologia e Historia (see Notes and News, *American Antiquity*, July 1952, p. 100), with Pablo Martinez Del Rio as Director. Funds were provided by Antonio J. Bermudez, Director General of Petroleos Mexicanos, and by Antonio Martinez Baez, Secretary of the Economia Nacional.

In July 1950, Aveleyra and Maldonado-Koerdell visited the little town of Santa Isabel Iztapan, about 2 kilometers south of Tepexpan, where workers opening an irrigation ditch had found fragments of bone and tusks of mam-

[1]Based upon the article "Asociación de artifactos con mamut en el Pleistoceno superior de la Cuenca de Mexico" in *Revista Mexicana de Estudios Antropológicos* (Sociedad Mexicana de Antropologia), Tomo XIII, Num. 1, pp. 3-29, Mexico, 1952. This publication is the second to come from the Instituto Nacional de Antropologia e Historia. A literal translation was made by Frederick Ruecking, Jr., which A. D. Krieger has considerably reduced and abridged. The original should be consulted for further photographs of the site, the artifacts *in situ*, a general map, and some statements which are here very freely rendered. Practically all of the objective data are here included.

moth. The authors were able to identify the remains as belonging to *Mammuthus* (*Archidiskodon*) *imperator* Leidy from one well-preserved molar and parts of the skeleton. The remainder of the skeleton remained covered by the overlying strata, but it was indisputably within a Pleistocene level equivalent to the lower part of the Upper Becerra formation. Circumstances prevented further investigation at the time.

Early in March 1952, Aveleyra, with the cooperation of Arturo Romano, began excavation of the Santa Isabel Iztapan locality. Maldonado-Koerdell took charge of stratigraphic and paleontological studies. On March 13, after four days work, Aveleyra found the tip of a projectile point imbedded between two ribs on the left side of the animal (Fig. 101 and Fig. 105, *1*) indisputably in primary association with the skeleton. Two more implements of obsidian and stone, respectively (Fig. 105, *3*, *4*) were also discovered in clear association by Aveleyra, while Maldonado-Koerdell found an obsidian scraper, broken at one end (Fig. 105, *2*). These four artifacts were left in place and work suspended so that recognized authorities in prehistoric archaeology might serve as witnesses to the discovery.

FIG. 101. Projectile point in place between two ribs, base projecting outward. This specimen is also shown in Figure 105, *1*.

Among those who viewed the discovery before the mammoth skeleton was removed were: Alfonso Caso, Ignacio Marquina, Daniel F. Rubin de la Borbolla, Eusebio Davalos Hurtado, Ignacio Bernal, A. R. V. Arellano, and Frederico K. G. Mullerried of Mexico; Marie Wormington of the Denver Natural History Museum, E. H. Sellards, director of the Texas Memorial Museum, and Alex D. Krieger, archaeologist of the University of Texas; and G. Stresser-Pean of the Museum of Man in Paris. On March 19, 1952, three of the artifacts (Fig. 105, *1-3*) were removed from the remains in the presence of most of the above persons. The fourth artifact (Fig. 105, *4*) had slipped overnight from its original position near a vertebra (Fig. 106) into the ground water.

Upon resumption of the work, Sra. Sol Arguedas R. de la Borbolla and Martinez Del Rio discovered two more artifacts, of obsidian and flint, respectively (Fig. 105, *5*, *6*) also in clear association with the mammoth. The major portion of the skeleton was recovered, partly articulated and partly strewn about (Figs. 102, 103, 106). Although most of the skull and tusks had been destroyed in the ditch operation in 1950, one complete lower right molar was salvaged (Fig. 107), as has been mentioned. Twenty-one sacks of argillaceous sand were collected near the skeleton for later geochemical determinations.

In May 1952 the site was visited by V. P. Sokoloff of Johns Hopkins University, accompanied by archaeologist Jose Luis Lorenzo and anthropologist Arturo Romano of the Direccion de Prehistoria, to take further samples for geochemical determinations which might serve to determine the age of the geologic strata. In July, de Terra took samples for radiocarbon dating, while Paul B. Sears of Yale University and Mrs. K. Clisby of Oberlin College collected samples for analysis of pollen and other vegetal remains.

STRATIGRAPHY AND PALEONTOLOGY*

The site of the excavation, about 2 kilometers southwest of Tepexpan and west northwest of the village of Santa Isabel Iztapan, Municipality of Atenco, State of Mexico, is in the northeastern part of the dry plain left by the shrinking of Lake Texcoco. The general inclination is toward the west, in the direction toward

* This section by Manuel Maldonado-Koerdell.

which the lake retreated from this point. Here and there are small propagated "tlateles," and toward the villages of Tequisistlan and Santa Isabel Iztapan is a somewhat greater elevation of land. Cereals and vegetables are raised with some small irrigation works. Some trees grow in the vicinity but the major part of the plain is pasturage, interrupted by areas of salt brine toward the southwest, nearer the present lake.

At the excavation, the geologic column is as follows:

1. Vegetal soil .....35 cm.
2. Argillaceous sand of a dark color with some small roots and small gastropods (*"Planorbis"* sp.) ..60 cm.

Disconformity

UPPER BECERRA FORMATION

3. Argillaceous sand, fine grained and of a reddish-brown color with small argillaceous concretions of yellowish color and some gastropods (*"Planorbis"* sp.) .....20 cm.
4. A sandy material, fine grained, with a pale greenish color, mixed with some amount of clay and — near the bottom of the excavation — with material of bentonitic aspect and numerous gastropods (*Limnaea* sp., *Helisoma* sp., *Paludestrina* sp., *Succinea* sp., *Physa* sp. .....65 cm. +

The vegetal soil has the usual character in regard to color and texture of the present plain of the Valley of Mexico. Over the surface are small salinitrous spots and the natural vegetation is somewhat more abundant than where the Tepexpan human skeleton was found, toward the north.

The second layer, considered equivalent to the Totolzingo "earth," clearly shows that it was deposited under water at a certain distance from the shore of the ancient lake. Its thickness indicates a long period of sedimentation, and its texture and composition contrast with the vegetal layer above and the Becerra formation beneath. The presence of small roots is obviously due to the present-day vegetation being able to penetrate to this level.

The disconformity between layer 2 and the Becerra is perfectly marked and probably represents a period of changeable weather and erosion, toward the end of the Pleistocene and the beginning of the Recent, that affected the geochemical composition of the upper part of the Becerra formation, for it contains a high proportion of carbonates and its color contrasts with that of the lower part. There is no

FIG. 102. General view of excavation, looking northwest. The Tepexpan fossil human skeleton was found toward the hill margin beyond the tree at the right of the picture, 2 km. north.

caliche over this formation, such as was observed at the site of the Tepexpan skeleton and other sites nearby, but these geochemical characteristics seem to indicate a temporary period of desiccation of the ancient lake that exposed the upper part of the Becerra formation to the action of atmospheric factors, resulting in the concentration of carbonates at this level. Together with the disconformity, this

FIG. 103. Greater part of mammoth skeleton with isolated femur in background. Irrigation ditch which destroyed skull is at left. View toward northwest. The upper limit of the "limo verde" is marked by the lowest string. Ground water is at normal level.

seems to indicate that the paleo-ecological conditions at Santa Isabel Iztapan were very similar to those which caused the layer of caliche to form on top of the Becerra formation at the fossil man site of Tepexpan.

The said formation, whose actual depth is unknown at Santa Isabel Iztapan, has an aspect and composition peculiar to its lacustrine facies, as Arellano (1951) has defined it. In its lower part it contains a certain proportion of bentonitic material, abundant gastropods, and the skeleton of the mammoth, which was *entirely* within it. For descriptive purposes it has been called the "green muck" (*limo verde*) from its texture and coloring, which clearly contrasts with the ruddy appearance of the upper part. This "green muck" surrounds and covers the mammoth skeleton completely, and 21 samples of this material were removed for microscopic analysis. Although the excavation reached more than 3 m. in depth, the base of the Upper Becerra formation apparently has not been reached at this locality.

The highest part of the mammoth skeleton (the spinous process of a dorsal vertebra) was 1.60 m. below the ground surface. The skeleton lay on an east-west axis with the head (destroyed by the ditch digging) toward the west or southwest. This orientation may indicate that the animal was pursued by hunters toward the lake margins from the higher ground to the east, until it became mired or weakened. One of the femurs lay a short distance from the remainder, as though pulled aside for butchering. It is unbelievable that predatory animals could have moved a bone of such weight, although other natural factors such as a river entering the lake, or strong waves, probably could have done it. The skeleton was completely fossilized and in excellent preservation. Possibly after butchering the remains were exposed to the elements for a time, for the projectile point (Fig. 105, *1*) shows a patina.

The molar (Fig. 107) belongs to the right side of the mandible and is that of an imperial mammoth, *Mammuthus* (*Archidiskodon*) *imperator* Leidy, as indicated by the general shape of the molar and the disposition of the transverse crests, etc. It was compared with similar fossils in the Instituto de Geologia, Universidad Nacional de Mexico, with materials in the Department of Vertebrate Paleontology at the University of Texas, and at the Texas Memorial Museum, Austin. E. H. Sellards, Director of the Museum, kindly placed at our disposal the collections of his institution and had the accompanying illustration of the molar prepared.

As to the remainder of the skeleton, all of the vertebral column, the ribs, majority of the long bones, a scapula, the pelvic girdle, and a great quantity of short bones — probably about 80 per cent of the total — were recovered. It is probable that other bones were destroyed by exposure or were taken away by the hunters. In the long bones, incomplete ossification between the epiphysis and diaphysis indicates that the animal had not yet reached maturity, although it was a well-developed individual for the bones had reached large dimensions.

FIG. 104. Stratified north wall of excavation. On top of bank is loose earth, below which are the four strata outlined in text. The disconformity is at the base of the darkest zone.

Associated Artifacts*

The six artifacts so clearly associated with the Iztapan mammoth have considerably enriched the small collection of tools in the Valley of Mexico whose Pleistocene age is no longer subject to doubt. In addition to de Terra's publication (1949), in which he proposed a sequence of preceramic lithic industries in the Valley of Mexico (later reviewed and evaluated by Aveleyra, 1950), a number of prehistoric and paleontological investigations have been undertaken by the authors and associates which culminated in the discovery of the Iztapan mammoth. Other recent proofs of the contemporaneity of man with fauna of the last Pluvial age have been obtained in the famous fossil beds of upper Pleistocene age at Tequixquiac at the extreme northern rim of the Valley of Mexico (Maldonado-Koerdell and Aveleyra, 1949). Still more recent discoveries there have yet to be published.

The excavation at Iztapan was conducted like that of a human burial with offerings, leaving all the skeletal parts in their original position on an earthen platform. Five of the artifacts were left in place until an exhaustive photographic record had been made and the ground plan (Fig. 106) drawn.

1. The first artifact (Fig. 105, *1*) was found by Aveleyra on March 13 while cleaning the matrix from between two ribs on the left side of the skeleton. It is a projectile point of flint and was pointed inward toward the chest, but could hardly have mortally wounded the mammoth. Its missing tip could not be found even with the most careful screening of the sand in contact with the skeleton. A recent break at one corner of the stem shows that the flint was originally a dark grayish color, in contrast to the white patina which curiously runs diagonally across both faces. This patina suggests partial exposure of the artifact to weather or natural agencies for a long time.

The edges of the body of the point are parallel in the lower one-third, then converge gently toward the tip. The artifact is 60 mm. long, to which perhaps 10 or 15 mm. should be added for the tip, and the greatest width is 27 mm. It is quite thin and delicate due to fine flaking. The flaking is somewhat irregular, and the scars unequal in length and width. There is no medial ridge as in the case of

* This section by Luis Aveleyra Arroyo de Anda.

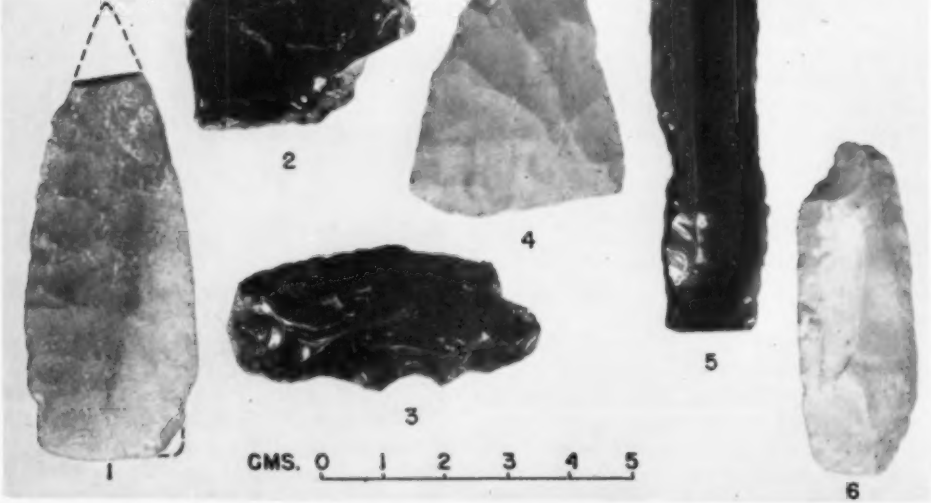

Fig. 105. Six artifacts associated with Iztapan mammoth. For position see Figure 106 with corresponding numbers.

parallel-flaked points of the Eden variety (Wormington, 1948). There is extremely fine pressure retouching along the edges. It seems indisputable that this Iztapan point can be classified with the Scottsbluff group, although it is not exactly typical of this type, first found associated with fossil bison in Nebraska, and later in various sites of the Great Plains (Barbour and Schultz, 1932; Schultz and Eiseley, 1935). The general characteristics of Scottsbluff points are given by Krieger (1947) as follows:

> They are not collaterally flaked, the flake scars being roughly parallel across the blade, or irregular . . . the faces are well rounded and often very well chipped . . . they also lack the long parallel edges of Eden points, the whole artifact being notably wider and the blade edges parallel only a fourth or a third of the distance forward before they begin to curve toward the tip. The stem is also more prominent than on Eden points, the right-angular notches being cut inward strongly one-half to three-quarters inch above the base. The base itself is typically quite straight. . . .

Wormington (1949) states that Scottsbluff points "in certain form resemble the Eden type, but the blade is wider and flatter. The median ridge is less marked and the shoulders more pronounced than in the Eden type. The flaking is sometimes of the typical horizontal, parallel form, sometimes more irregular." Although both Krieger and Wormington have used the term "Yuma" in connection with Scottsbluff and Eden points, they now urge that the term "Yuma" be abandoned completely.

The Iztapan specimen agrees with the general features of the Scottsbluff type in shape, proportions, and flaking technique, the principal difference lying in its thinness. Is it possible to suggest that the Iztapan point is an ancestral form from which the classic form of the Great Plains was derived? This would presuppose a greater antiquity for the Mexican specimen, which finds some confirmation in radiocarbon dates given for the Becerra formation in the region of Tepexpan. The "green muck" lacustrine facies of the Becerra, in which the Iztapan mammoth was enclosed, is provisionally calculated at between 10,000 and 12,000 years. Scottsbluff points in the Great Plains, where it has been possible to date them, have always appeared in post-Folsom deposits and do not surpass approximately 8,000 years. The Scottsbluff points found at Lime Creek site, Nebraska, were once estimated to be more than 20,000 years old (Wormington, 1949), but more recent radiocarbon datings give an age of less than 10,000 years (Roberts, 1951).

Apart from this, Scottsbluff points in the United States have always been found associated with fossil bison (when found with extinct fauna), while in the case of Iztapan this type appears for the first time in positive association with a mammoth. The Iztapan point is also the first shouldered projectile point to be found in direct, positive association with this mammal on the continent. Wormington, who examined the Iztapan specimen personally, has noted that very recently similar points were found at the Cody site in Wyo-

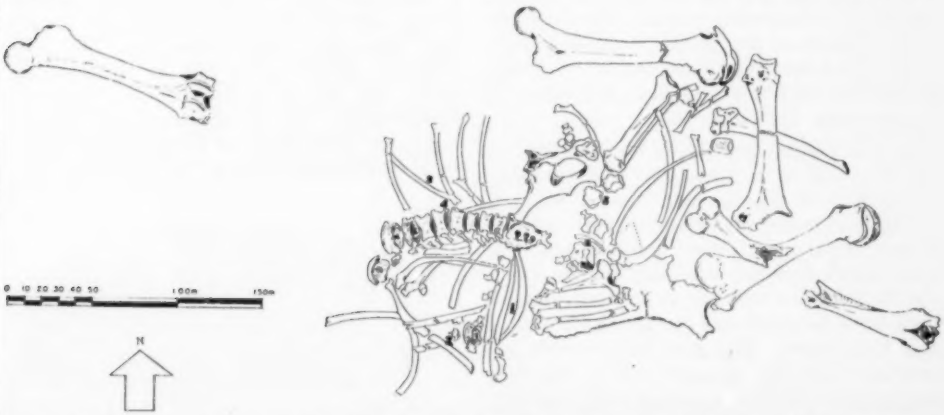

FIG. 106. Ground plat of mammoth skeleton showing original position of associated artifacts. The numbers correspond to Nos. 1-6 in Fig. 105.

ming, associated with fossil bison. Only a short note, without illustrations (Jepsen, 1951) has been published on this discovery, from which it is premature to look for close affinities.

2. The second artifact (Fig. 105, *2*) was found on March 14 by Maldonado-Koerdell while clearing off a rib with needle and brush, near the first artifact. It is a two-edged scraper of black obsidian with a greenish tinge. The chipped edges are parallel and worked by means of very fine, though irregular, pressure retouching. Only the edges show workmanship, the remainder of the dorsal face presenting only large flake scars, and the ventral face simply a large percussion face without flaking. A percussion bulb with clear concentric waves, and a typical hinge fracture may be seen on the ventral face. This artifact is 36 mm. long with a maximum width of 27 mm.

3. The third artifact was encountered on March 15 by Aveleyra, under a rib and below the last lumbar vertebra. It is a flake knife of the same obsidian with greenish tinge, 50 mm. long and 24 mm. wide (Fig. 105, 3). It apparently had a double function. The dorsal face is flaked with relatively ample scars, irregular and without retouching. One edge is crudely pressure retouched to form a scraping edge in a wide arc, while the other bears three concentric arcs, the central one being the deepest, obviously to serve as a "spokeshave," possibly for rounding and planing atlatl shafts. The ventral face presents the bulb of percussion at one end and the hinge fracture at the other, as in the second artifact. Identical artifacts, interpreted in the same manner, have been found with some frequency in various localities in the United States, including that at Lindenmeier, Colorado.

4. The original position of the fourth artifact (Fig. 105, 4) was, without doubt, directly below and in contact with one of the last lumbar vertebrae, a few centimeters from 3. It was found by Romano and Aveleyra in a loosened clod of clay on March 17, and was the only artifact not left in its original position, for it later fell into the ground water. It is a fine-grained, clear gray flint, roughly triangular in outline. Along the base, one face was pressure-flaked into a steep bevel, hence it is provisionally classified as an end scraper. There is almost no retouching of the other edges. It might also be regarded as a pointed implement held in the hand. It is 43 mm. long and 35 mm. wide.

There is a surprising similarity between this artifact and specimens recently described from the region of Falcon Dam on the Rio Grande in northern Tamaulipas (Aveleyra, 1951). The University of Texas collections from the American side of the reservoir include a number of "end scrapers" of this type, some of which are duplicates of the present specimen in all details. There is also a certain typological relationship between this specimen and another "hand point" of flint recently found *in situ* in the gravels at the base of the Upper Becerra formation at Tequixquiac (Maldonado-Koerdell and Aveleyra, 1949).

5. On March 28, after excavation had been resumed following the removal of 3 of the first 4 artifacts in front of witnesses as mentioned in the opening section, Aveleyra and Sra. Sol Arguedas R. de la Borbolla continued to search for additional artifacts. Sra. Borbolla found a long prismatic flake knife of greenish obsidian, partly encrusted, under one of the patellas. This measures 59 mm. in length and 17 mm. in maximum width (Fig. 105, 5). The dorsal face presents three percussion planes running the full length of the specimen. In the center, immediately below the large striking platform, there is a negative bulb of percussion and concentric rings that give evidence of the previous removal of another such knife from an original core. At the end opposite the striking platform, the blade is broken straight across, suggesting that it was once much longer. Both edges are pressure-retouched. The right edge (in the illustration) is retouched along about half the total length, very fine and regular work. The left edge shows an indentation near the middle, with ragged but doubtlessly intentional flaking, which must have

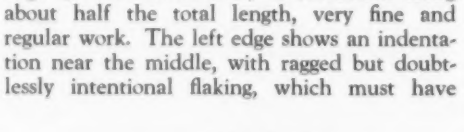

FIG. 107. Lower right molar of Iztapan mammoth. Length of crown about 22 cm., width about 8 cm.

served for cutting and possibly as a "spokeshave." On the ventral face, well-marked waves radiate from the bulb of percussion.

For comparative purposes, this artifact is not very diagnostic. Hundreds of similar knives can be found on the surfaces of *milpas* and hill slopes all over the Valley of Mexico. If this specimen had been found on the surface it could not have been distinguished from identical implements made until the time of the Conquest. Its unquestionable association with the Iztapan mammoth shows that this elemental technique of removing long prismatic flakes from obsidian cores was continued for more than 100 centuries in the Valley of Mexico.

6. The last artifact (6) was discovered on March 29 by Martinez del Rio when all the persons who had taken part in the excavation were present. It is a clear gray flint blade, 54 mm. long and 19 mm. in maximum width. It has marginal retouching, extremely fine and delicate, along both edges of the dorsal face, which also has several large flaking planes without later workmanship. The upper end (in the illustration) bears pressure flaking extending half way around the end, next to which an intentionally-made open break is noticed. The face of this break lies obliquely in relation to the long axis of the implement, forming a sort of hook or curved beak. Although this detail might be sufficient for some American archaeologists to classify the tool as a burin, it is preferable to adhere to the European definition of a burin which requires that burin blows be clearly present (for further discussion by an eminent typologist of French Paleolithic implements, see Bourlon, 1911). The ventral face of this artifact which for this reason must be classified only as a retouched blade, consists of an even plane of percussion, without a bulb or waves.

CONCLUSIONS

Considering the implements as a whole, some additional observations seem pertinent. In the first place, attention should be called to the typological variety, which actually constitutes a small industry. Surely the one atlatl or spear point was not the only weapon employed against so formidable an animal. An explanation has already been offered by Martinez del Rio (1952) in that these points, however much they were used in the hunt, were not the principal cause of death of the proboscideans. Their function may have been primarily to irritate and wound the animals, so that, weakened by loss of blood and frightened by the cries of the hunters, they fled toward the marshy margins of the lake and mired down until they died, more through exertions and contusions from rocks thrown against the head, or from long wooden spears thrust into the body.

The presence of cutting tools is indisputable evidence of butchering, confirmed by the arrangement of the bone fragments, partially displaced and piled up. It does not seem possible that natural agencies could have caused such displacement at this point, for the argillaceous sands enclosing the remains are sediments deposited in quiet waters at the bottom of a lake. Especially notable is the case of the heavy femur, isolated from the rest of the skeleton by more than 2 m.

The implements show that the hunters used both flint and obsidian. Although the series is very small, there is some suggestion that flint was preferred for artifacts of a penetrating function (the projectile point, the triangular point or end-scraper, and the pseudo-burin), and obsidian for cutting implements (the flake knives or scrapers, two of them also having "spokeshaves").

Although there are not yet any fundamental similarities or patterns, owing to the still great scarcity of diagnostic artifacts in the Pleistocene of the Valley of Mexico, it is advisable to include the Iztapan artifacts provisionally within the San Juan group created by de Terra. Their approximate contemporaneity, geographical proximity, and their connection with the nomadic hunting of great mammals, seem to justify this assertion.

The results obtained in the excavation of the Santa Isabel Iztapan mammoth confirm once and for all the existence of man as a hunter of these animals in the Tepexpan region, as the work of Arellano and de Terra had previously suggested. This area, aptly called "the reservoir of the elephants" by Martinez del Rio, adds greatly to our knowledge of prehistory in the New World, and may be expected to add much more.

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THE CENTRAL CALIFORNIA CHRONOLOGICAL SEQUENCE RE-EXAMINED*

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FOR A NUMBER OF YEARS the subject of California archaeology has undergone a great deal of discussion. A large measure of this discussion has been concerned with the problem of chronology. Heizer (1949) has postulated a classification of cultural and temporal relationships for central California. His chronology is based primarily on stratigraphic sequences together with intrasite comparisons and geological-chemical soil and bone analysis.

This paper is an attempt to examine a part of his sequences using a new method for the chronological ordering of archaeological deposits (Brainerd 1951; Robinson 1951). The material to follow will be divided into three categories: 1) theory and method; 2) a discussion of the sequences resulting from the application of the method used here; and 3) the nature of the conclusions which one may safely draw in the light of 1) and 2) above.

The purpose is *not* to test the theoretical validity of the Brainerd-Robinson method. To be sure, it contains certain statistical and archaeological implications which have yet to be fully examined and tested on a strictly theoretical basis, but we will assume here that the theory has a sound theoretical base. What will concern us is the empirical testing of this method. That is, we will select a series of sites for which a reliable chronological sequence has already been established. Then, using these same sites, we will establish a sequence using the new method. If both sequences exhibit similar patterns, we will then have strong presumptive evidence that our new method is working. If dissimilar sequences result, then this method would be open to some doubt, and changes in our techniques would be in order. It may be noted here that the empirical testing of the Brainerd-Robinson method has been, to this date, limited to only a few cases. Brainerd has tested several known sequences — with good results; Rozaire (n.d.) has used this method to establish a chronological sequence of some sites in Southern California; there was, however, no acceptable sequence to check it against; Belous (n.d.) checked Olson's (1930) sequence of some Santa Barbara sites — with rather indecisive results. At this point, then, it is safe to say that while this method has not acquitted itself on all counts, neither has it produced negative results. This, in brief, is the reason for this paper.

We shall summarize briefly the theoretical basis upon which this work rests. Since the paper by Brainerd and Robinson is admittedly a progress report only and was not intended to be the final word on this question, we are limiting ourselves to a summary with perhaps a few suggestions as to those theoretical aspects of the problem which might require new and/or additional lines of investigation.

The Brainerd-Robinson method is based upon both statistical and archaeological theory. Archaeologically it is founded "upon the empirically established fact that, over the course of time, [artifact] types come into and go out of general use by a given group of people" (Robinson, 1951, p. 293). This concept — that each type originates at a given time, at a given place, is made in gradually increasing numbers as time goes on, then decreases in popularity until it becomes forgotten, never to occur in an identical form (Brainerd, 1951, p. 304) is the basis for the analytic technique whereby collections of artifacts may be placed in a time-space framework.

> If in a mass of cultural material from a single region, a series of artifact types follows the course outlined above [that is, assuming lenticular patterns for the varying frequencies of the types through time], each originating more or less independently of another, the corollary may be drawn that if a series of collections comes from a culture changing through time, their placement on the time axis is a function of their similarity; collections with closest similarity in qualitative or quantitative listing of types lie next to each other in the time sequence. This corollary allows a "seriation" or ordering of collections to be formed which, if time be the only factor involved, must truly represent the temporal placing of the collections, although determination of the direction early to late must be obtained by other means. Stratigraphic excavations have abundantly confirmed this general disposition of artifact types through time in archaeological deposits (Brainerd, 1951, p. 304).

This, then, is the archaeological basis upon which the statistical work by Dr. Robinson was applied. The problem, essentially, was that of

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obtaining a mathematical measure of similarity among collections which would depend upon the comparative frequencies of a considerable number of types common to the collections. This measure, or index of agreement, tells us how similar (or dissimilar) the percentage distributions are for various pairs of deposits. After we have thus determined numerical values for the agreement between the percentage distributions of our deposits in all possible combinations of two, we then have numerical indices of how close together temporally all possible pairs of these deposits are. These indices are then arrayed in a matrix, the proper arrangement and interpretation of which is our most important (and difficult) problem. This process will be discussed at some length later.

Since we were primarily interested in the empirical testing of this new method, it was necessary, first of all, to choose a collection of sites for which there is a generally acceptable chronology. This would enable us to check our results. Furthermore, there must be sufficient data available — both in type and number — to obtain valid statistical results. Heizer's Central California sites seemed to satisfy, for the most part, both criteria.

The second step was to choose those sites which could best be used in this study. Their choice was largely dictated by two factors: 1) the availability of published reports; and 2) the preference for those sites whose artifact collections were classified by the same people since, as we shall see later, it is necessary that we have as consistent identification of types as is possible. For these reasons, we use the Lillard, Heizer, and Fenenga (1939) report, supplemented by Heizer's (1949) paper on the Early California horizon. Of the 15 sites listed in the 1939 report, we have used 12; no numerical tabulation was available for the other 3. Four of the 12 sites stratigraphically exhibited at least 2 time levels within each (e.g. early and late.) For this reason, we divided these sites as follows: C.*107* into C.*107*-C (early or lowest level) and C.*107*-*AB* (middle and upper level); C.*142* into C.*142*-*B* (lower level) and C.*142*-*A* (upper level); *S.60* into *S.60*-*C* (which Heizer calls Transitional) and *S.60*-*AB* (including Heizer's Late Period, Phases I and II); *S.1* into *S.1*-*B* (Heizer's Late Period, Phase I); and *S.1*-*A* (Phase II). We have considered each of these subdivisions as a collection; thus our work will include sixteen units — hereafter called sites.

Our third step was the selection of the artifact types, a choice primarily dictated by statistical requirements. Since we are interested in tracing the course of each artifact through time, it is obviously necessary to select artifacts which occur in as large numbers as possible, but the artifact types must also each be represented in several of the sites. We have somewhat arbitrarily selected only those artifacts which occur in at least half of the sixteen sites. After a careful tabulation of the occurrence of each of the almost two hundred types listed in the 1939 report, we found that there were thirty-four types sufficiently represented among the sixteen sites. While it is not in our province here to discuss the question of the formulation of "types," it may be noted that there is some disagreement concerning this problem. Krieger, for example, would restrict his definition of a type to a sorting group which demonstrates chronological or regional significance (Krieger, 1944, p. 285). While we would not hesitate to use such types in this study, we need not so restrict our definition of types because, as one of the by-products of our procedure, we will presumably demonstrate such significance. As we shall use the term here, a type "must be of such complexity in number and organization of attributes that the presence of an artifact belonging to it suggests that its maker lived in the same cultural milieu as that of makers of all other artifacts classified into the same sorting group; . . . [each group having been made] at approximately the same time and place" (Brainerd, 1951, p. 304). This concept — that of a sorting group — will be used here as our definition of a *type* and we believe the groups we have chosen in general conform to this definition.

The fourth step was to array the sites and types in Figure 108. The purpose of this tabulation is to allow the calculation of the percentage of occurrence of each type throughout the sites. From these percentages the indices of agreement are obtained, and thus the matrix is formed. Several methods can be used to determine the percentage(s) of each artifact. The particular method used will depend upon the kind of data which is available. For example, if numbers of each type are listed, and we had, say, one thousand artifacts (in-

	C 107- C	C 107-AB	C 68	C 142- B	C 142-A	C 56	C 66	S 99	S 60- C	S 60-AB	C 141	S 66	S 250-	C 150	S 1- B	S 1- A
NO. OF BURIALS	59	109	88	44	10	71	95	79	71	19	27	50	20	12	48	6
NO. OF BURIALS WITH ASSO. ARTIFACTS	54(91.5)	62(56.9)	50(56.8)	36(81.8)	10(100.0)	47(66.2)	44(46.3)	41(51.9)	30(42.3)	18(94.7)	16(59.3)	39(78.0)	19(95.0)	11(91.7)	32(66.7)	5(83.3)
BURIALS FULLY EXTENDED VENTRALLY	46(77.9)		40(45.5)	41(93.2)		69(97.2)	1(1.1)		3(4.2)		4(14.8)					4(66.7)
FULLY EXTENDED DORSALLY	2(3.4)		13(14.8)	2(4.5)			1(1.1)		1(1.4)	1(5.3)	14(51.9)					2(33.3)
FLEXED ON SIDE OR BACK	3(5.1)	103(94.5)			5(50.0)		67(70.5)	70(88.6)	66(93.0)	11(57.9)	4(14.8)	39(78.0)	15(75.0)	11(91.7)	43(89.6)	
WESTERLY ORIENTATION	52(88.1)	40(36.7)	50(56.8)	44(100.0)	2(20.0)	70(98.6)	39(41.1)	24(30.4)	21(29.6)	11(57.9)	9(33.3)	23(46.0)	3(15.0)	5(41.7)	4(8.3)	2(33.3)
EASTERLY ORIENTATION	1(1.7)	21(19.3)			2(20.0)		17(17.9)	21(26.6)	16(22.5)		9(33.3)	4(8.0)	11(55.0)		8(16.7)	3(50.0)
NORTHERLY ORIENTATION		6(5.5)			1(10.0)		7(7.4)	6(7.6)	8(11.3)		2(7.4)	2(4.0)	3(15.0)	4(33.3)		
CREMATION		14(12.8)			5(50.0)		5(5.3)	2(2.5)	2(2.8)	5(26.3)	2(7.4)	13(26.0)	1(5.0)			
FLAKED POINTS ALL TYPES	14(23.7)	36(33.0)	22(25.0)	13(29.5)	2(20.0)	14(19.7)	10(10.5)	2(2.5)	1(1.4)		1(3.7)	17(34.0)	2(10.0)	3(25.0)	3(6.3)	3(50.0)
FLAKED POINT TYPE NAb1	3(5.1)	3(2.8)		1(2.3)			4(4.2)	3(3.8)	1(1.4)			2(4.0)	1(5.0)	1(8.3)	1(2.1)	1(16.7)
NAb2	2(3.4)	1(0.9)			1(10.0)	2(2.8)	1(1.1)					1(2.0)				
SAa	3(5.1)	11(10.1)		6(13.6)	1(10.0)	8(11.3)	2(2.1)	2(2.5)				1(2.0)				
SBa	5(8.5)	11(10.1)		2(4.5)		5(7.0)	2(2.1)					3(6.0)				
SCa1		5(4.6)		2(4.5)		3(4.2)						3(6.0)	1(5.0)			
OBSIDIAN POINTS				7(15.9)	2(20.0)	2(2.8)	9(9.5)	3(3.8)	5(7.0)		4(14.8)	14(28.0)		2(16.7)		
SLATE, CHERT POINTS				11(25.0)	2(20.0)	10(14.1)	3(3.2)	3(3.8)	2(2.8)			2(4.0)		3(25.0)		
OLIVELLA SHELL BEADS ALL TYPES	20(33.9)	28(25.7)	26(29.5)	18(40.9)	5(50.0)	13(18.3)	8(8.4)	10(12.7)	8(11.3)	11(57.9)	20(74.1)	29(58.0)	19(95.0)	5(41.7)	11(22.9)	5(83.3)
OLIVELLA BEAD TYPE 1a	12(20.3)		19(21.6)	11(25.0)	4(40.0)	6(8.5)			1(1.4)		2(7.4)					
1b		7(6.4)				2(2.8)	1(1.1)			3(15.8)		11(22.0)	3(15.0)	1(8.3)	7(14.6)	2(33.3)
2a		1(0.9)				4(5.6)				6(31.6)	4(14.8)	12(24.0)	7(35.0)	4(33.3)		3(50.0)
3b		1(0.9)		1(2.3)	5(50.0)		6(6.3)	10(12.7)	6(8.5)		3(11.1)					
3c		1(0.9)			4(40.0)		1(1.1)		1(1.4)		5(18.5)		2(10.0)			
HALIOTIS SHELL BEADS ALL TYPES	34(57.6)	1(0.9)	12(13.6)	20(45.5)	2(20.0)	14(19.7)	1(1.1)	4(5.1)	2(2.8)							
HALIOTIS SHELL TYPE 1a	26(44.1)		12(13.6)	19(43.2)		14(19.7)										
HALIOTIS ORNAMENTS ALL TYPES	20(33.9)	73(67.0)	26(29.5)	15(34.1)		25(35.2)	8(8.4)	19(24.1)	8(11.3)	2(10.5)	20(74.1)	29(58.0)	9(45.0)	4(33.3)	17(35.4)	1(16.7)
HALIOTIS ORNA TYPE B 1.		6(5.5)					3(3.2)	2(2.5)	3(4.2)		2(7.4)	3(6.0)	1(5.0)		9(18.8)	
C (1) a	1(1.7)		6(6.8)	2(4.5)		4(5.6)			1(1.4)				3(15.0)			
QUARTZ CRYSTALS	12(20.3)		14(15.9)	15(34.1)	2(20.0)	20(28.2)	7(7.4)	5(6.3)	5(7.0)		1(3.7)	1(2.0)	1(5.0)			
CHARMSTONES ALL TYPES	40(67.8)	2(1.8)	8(9.1)	3(6.8)	1(10.0)	12(16.9)	1(1.1)	3(3.8)								
POWDERED RED OCHRE ON BONES	6(10.2)	1(0.9)	2(2.3)	4(9.1)		5(7.0)	6(6.3)	6(7.6)	8(11.3)		1(3.7)		5(25.0)			
MANO, METATE, MORTAR PESTLE, BONE HOOKS	5(8.5)	9(8.3)	4(4.5)		3(30.0)		4(4.2)	8(10.1)	5(7.0)	2(10.5)	2(7.4)	13(26.0)	1(5.0)	1(8.3)		
MORTAR, PESTLE ALL TYPES		7(6.4)	1(1.1)		3(30.0)		3(3.2)	6(7.6)	5(7.0)		2(7.4)	8(16.0)	1(5.0)	1(8.3)		
STONE SPLINTERS	10(16.9)	3(2.8)	2(2.3)	7(15.9)		1(1.4)	1(1.1)					3(6.0)				
PEBBLES, PENDANTS	5(8.5)	4(3.7)	3(3.4)	1(2.3)		9(12.7)	6(6.3)	7(8.9)	9(12.7)		2(7.4)	10(20.0)	1(5.0)			
BONE TOOLS, AWLS																
TOTALS	376	457	310	286	74	359	268	257	207	89	129	280	106	56	145	31

FIG. 108. This table shows the sites used in this study and their corresponding artifact collections. In each box are two figures: the first indicates the number of burials in which the type occurred; the second, in parentheses, indicates the percentage of the type within the site. This latter figure is determined on the basis of the total number of the burial occurrences for the site.

cluding only those types which we had selected to use), then if there were one hundred manos, the percentage of manos for this site would be 10 per cent. This is the direct and simplest method. For the material which we have here, this method cannot be used since some of the sites do not have the artifact totals listed. Instead, we are given (in all sites) the number of burials in which each artifact type occurs. If we examine Figure 108 for example, we find that in Site C.*107*-C there are 5 burials in which the flaked point type S.*Ba* occurs. If we add up the number of all artifact occurrences for this site (376), we can calculate the percentage of "occurrence in burial" of type S.*Ba* in C.*107*-C (1.3 per cent).

It is apparent that the use of this latter method may present uncertainties. Primarily, they arise from the fact that a listing of artifact occurrences per burial does not necessarily represent a truly *quantitative* listing of artifacts. In order for us to plot adequately the course of an artifact on its time axis, we need to know the extent to which its occurrence varies as it passes through time. Now it is quite conceivable that "occurrence in burial" will not give us the information for which we are looking. They may, for example, indicate social privileges instead of reflecting chronology (Beardsley, 1948, p. 11). In a particular site of 50 burials, let us say, we find 150 points of type S.*Ba*; if each burial contains *three* points of this type, we will note *fifty* occurrences. At another site of 50 burials we find only 50 points — each burial now containing only *one* point of this type — so we again note *fifty* occurrences. Thus for each site, type S.*Ba* occurs in fifty burials; one site, however, has one hundred fifty points of this type, while the other has only fifty points of this type. Can both sites be compared on an equal basis? This may be a far-fetched example, but it is wise, at least, to note the presence of this problem. It would appear that the number of points, not the number of burials containing one or more points, is the true measure of artifact frequency. But our data do not give us this information.

The fifth step was the construction of the matrix. Working directly from the percentage distributions obtained above, we are able to determine the indices of agreement. As mentioned previously, these indices are numerical values for the measures of similarity between each site and all the others. To obtain this measure for any two sites, we simply add up the numerical differences between each of the artifact percentages. For example, the first artifact type in Figure 108 has a 14.3 per cent occurrence in C.*107*-C and a 13.6 per cent occurrence in C.*107*-AB. The difference between these two is .7 per cent. The second artifact type shows a difference of 12.2 per cent, and so on. When we add all of the differences between two sites, the final figure will indicate the measure of how much they *differ*. If we desire the measure of their similarity, we can subtract this figure from 200, the maximum value which the disagreement between two collections can take.

Having obtained the indices of agreement between all sites, the sixth step was to array them in a square table (Fig. 109). It can be seen that this table is symmetrical about its diagonal, both halves being the same. Actually, of course, only one of these halves is necessary for further computations, but there are advantages in using both of them (Robinson, 1951, pp. 296-298). A table of this sort can be read like a mileage chart on a road map. For example, the index of agreement between sites C.*107*-C and C.*56* is 148.0.

The final and most important step in this problem is the reordering of the above (initial matrix) so that the agreement coefficients exhibit the desired internal pattern. Before discussing this pattern, we want to emphasize that the order of the sites in the initial matrix (Fig. 109) was *in no way* influenced by any preconceived notions of how the final order of sites should look. This initial matrix is a result of the order in which the sites were described in the report. For subsequent reorderings of the matrix, we substituted letters of the alphabet (A through P) for the site numbers. It was *not* until the matrix exhibited the desired internal pattern that we reintroduced the actual site numbers.

The problem concerning this desired internal pattern, it seems to me, is two-fold. First of all, what should it look like? If we know this, what methods can we most effectively use to obtain it? Robinson (1951, pp. 298-301) examines these questions at some length and he remarks that the problem is essentially one of concentrating the high values (or agreement coefficients) around the diagonal of the table. In addition, there will be a tendency for these

(high) values to fall *below* the diagonal in the upper left-hand corner and to fall *above* the diagonal in the lower right-hand corner. Thus the values in any row read from left to right would grow *larger up to* the diagonal and would then *decline* in value after one crossed the diagonal. Ideally, high values will not appear in the lower left and upper right corners (Robinson, 1951, Table 21, p. 299). The result of conforming to a pattern such as this seems fairly obvious: a site containing mostly high values will normally be at or near the center of the matrix since its high agreement indices indicate that it is on the average closer in time to *all* the sites than to those at either end of the matrix.

Knowing, then, how the pattern should look, the problem is now to rearrange the deposits so that the agreement coefficients will exhibit the desired pattern. The methods for doing this are described by Robinson, and they appear to be entirely adequate — at least for the problem on which he and Brainerd worked. The first step in rearranging the deposits along the margins of the matrix consists merely in so ordering them that their column totals will show the ascending-descending pattern, which we have previously mentioned. Next, in order that we may more easily see the pattern which these coefficients assume, we then encircle in each column those which have the highest values. (It appears to be most efficient to encircle the higher half.)

It is obvious that, unless we are very lucky, the first two steps will only approximate the desired pattern. What is needed now is a simple criterion by which we can better rearrange the sites so that in each row the coefficients rise in value to the left of the diagonal and decrease in value to the right of it. The extent to which the values actually show this pattern is indicated by the number of negative signs in each row. For example: I, below, shows a row which does not conform to the desired pattern; Row II *does* exhibit the pattern;

I 5 – 4 – 3 – 2 – 1 – 1 – 2 – 3 – 4 – 5

II 1 + 2 + 3 + 4 + 5 – 5 + 4 + 3 + 2 + 1

The negative signs in Row I indicate that these values are not in their correct positions. This procedure — that of the placing of negative and positive signs — is repeated for each adjacent vertical row. The total number of negative signs between any two vertical rows will thus indicate the extent to which they are out of their proper position. It is felt that if the number of negative signs is more than half of the total number of coefficients for a row, then a different order must be obtained.

Since it seems obvious that the *size* of the difference ought to count as well as the *sign* of the difference, a fourth step in the construction of the matrix may be added. That is, we may square all of the negative differences and then express the sum of these squares as a fraction of the sum of the squares of all differences — positive and negative together. (The use of squares gives proportionately more weight to the larger differences.)

Having discussed the methods by which we may attain the desired pattern from our initial matrix, let us see how they have been used in this particular study. We would like to state, first of all, that the rearranging of a matrix — especially if it contains a large number of sites — is very likely to be an arduous task. The moving of only a single site means that the entire matrix has to be recopied. Fortunately, we had at our disposal an "ordering board" which made this task much easier. This board consists of a number of small rectangular blocks (one for each agreement coefficient) with two holes drilled through each

	C 107C	C 107AB	C 68	C 142B	C 142A	C 56	C 66	S 99	S 60C	S 60AB	C 141	S 66	S 250	C 150	S 1-A	S 1-B
C 107C		89	(52)	(164)	72	(48)	103	87	89	80	88	88	91	82	75	83
C 107AB	(89)		97	(94)	(88)	(88)	(43)	(39)	(33)	(31)	116	(48)	(129)	(35)	(45)	(99)
C 68	(52)	97		(156)	82	(153)	102	86	84	96	98	106	92	96	87	(117)
C 142-B	(164)	94	(156)		78	(163)	100	81	87	77	100	91	87	91	74	96
C 142-A	72	88	82	78		67	86	83	87	76	110	101	95	79	62	88
C 56	(48)	88	(53)	(163)	67		98	87	108	76	79	88	88	84	71	90
C 66	(103)	(43)	(102)	(100)	(86)	(98)		(165)	(168)	(103)	104	(125)	(141)	(133)	(133)	83
S 99	(87)	(39)	86	81	83	87	(165)		(173)	100	(105)	(122)	(142)	(128)	(129)	76
S 60-C	(88)	(33)	84	87	(87)	(108)	(168)	(173)		97	(112)	(119)	(135)	125	(132)	76
S 60-AB	80	(131)	96	77	76	76	103	100	97		(115)	(139)	121	(135)	(130)	(99)
C 141	88	116	98	(100)	(110)	79	104	105	112	(115)		119	110	101	99	(118)
S 66	88	(148)	(106)	91	(101)	88	(125)	(122)	(119)	(139)	(119)		(122)	(145)	(126)	(100)
S 250	(91)	129	92	87	(95)	88	(141)	(142)	(135)	(121)	(110)	122		(130)	(133)	(114)
C 150	82	(135)	96	91	79	84	(133)	(126)	(125)	(135)	101	(145)	(130)		(135)	(102)
S 1-A	75	(145)	87	74	62	71	(133)	(129)	(132)	(130)	99	(126)	(133)	(135)		93
S 1-B	89	99	(117)	(96)	(88)	(96)	83	76	76	99	(116)	100	114	102	93	

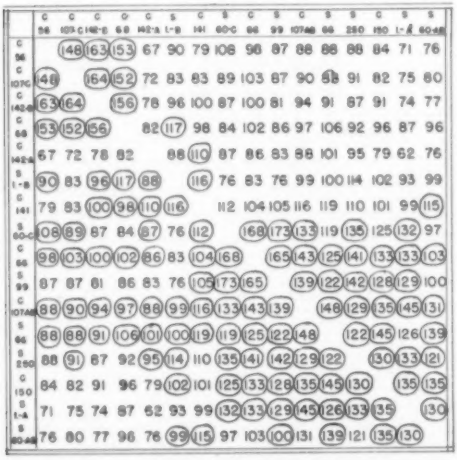
FIG. 109. This is the initial matrix constructed directly from Figure 108. Notice the extreme unevenness of the internal pattern. Percentage of negative differences is 41.9 per cent.

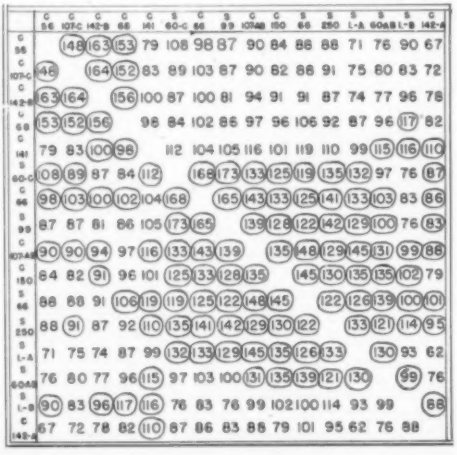
so that metal rods could be inserted. This allowed one to move both the horizontal and vertical rows of the matrix. In the center of each block, a small hole was drilled. In these holes wooden pegs were inserted, the height of each corresponding to the value of the agreement coefficient which that block represented. Thus, not only could a new matrix be quickly formed, but the pegs (and their corresponding heights) also showed us the resulting pattern at a glance.

Aside from the introduction of the above techniques, we followed the previously discussed methods as suggested by Robinson. In general, satisfactory results were obtained. Certain difficulties arose, which deserve discussion here. At this stage of our knowledge, we are not able to say whether these difficulties resulted from a deficient methodology or from something inherent in the data which we were using. We are inclined to think that it may well be a combination of the two.

Before discussing these difficulties in detail, let us examine Figure 112. It shows the matrix which we believe best exhibits the desired internal pattern. It is the product of more than 25 separate attempts to arrive at the pattern and was constructed without any knowledge of how Heizer's original chronology looked. As we said before, we followed Robinson's suggested procedure. His step Three was altered slightly in that we did not place a negative sign between two agreement coefficients unless they differed by more than five units. The initial patterning was considerably speeded up by this method. As a further refinement, we used, as noted before, a more sensitive measure of the agreement between the actual and desired pattern of agreement coefficients than is provided by the number of negatively signed differences (our step Four in the construction of the matrix). We have used this procedure on the four tabulations (Figs. 109, 110, 111, 112). Ideally, of course, it is desired that the sum of the squares of the negative differences be 0.0 per cent of the sum of the squares of all differences. In our work, Figure 109 (the initial, unordered matrix) showed that 41.9 per cent of all differences were negative; Figure 110: 19.2 per cent; Figure 111: 17.2 per cent; and our final matrix, Figure 112: 15.2 per cent. It is conceivable, of course, that even this latter figure might be reduced by rearranging our matrix. There is some doubt, however — at least in my mind — whether this method is actually a more sensitive measure (in determining the final matrix) than that of simply observing the patterns exhibited by the encircled values. We shall return later to this point.

The order of sites along the margin of Figure 112, thus indicates our final chronological sequence. One step in our process is still lacking — that which tells us which are the early and





Figs. 110 and 111. These show possible alternate arrangements of the sites. They do not show the best possible internal pattern. Percentages of negative differences are 19.2 per cent and 17.2 per cent respectively.

late ends of this sequence. We repeat that, in ordering the sites chronologically, we try rearranging them until we approximate the desired arrangement of agreement coefficients in the interior of the figure. If we can approximate this pattern, then there is strong presumptive evidence that the resulting marginal order is a chronological one —

> . . . for a table in which agreement coefficients have been scattered at random will not yield this pattern no matter how the deposits are re-arranged. The existence of order among the data, however, is not enough to guarantee that the order is a temporal one. It would undoubtedly be possible to imagine a situation in which the [desired] pattern . . . would result where the causative agent was not time but some other factor such as geographic proximity (Robinson, 1951, p. 295).

Thus, although we have attained the desired pattern, it is merely presumptive and not conclusive evidence of an underlying chronological order of the deposits.

> The presumptive nature (of our evidence), however, can be altered to practical certainty if appropriate collections of field data are available. All that is necessary is that deposits show chronological change through depth, so that a rudimentary chronology appears in each deposit. Each trench, that is, must have been segregated into two or more deposits, and it must be known which of these deposits is chronologically prior to the others (Robinson, 1951, pp. 295-296).

A glance at Figure 112 shows that the left side of the matrix (site C.56) is obviously the early end of our sequence. The lower levels (B and C) of all (except one) of our stratified sites appear earlier in the sequence than do their corresponding upper levels. From this, we thus have almost conclusive evidence that the underlying order of the sites in our matrix is a chronological one. (For another, more indirect, method see Brainerd, 1951, p. 311.)

Returning again to the difficulties encountered in the construction and interpretation of the matrix, we have said that they were primarily of a two-fold nature. On the one hand, our difficulties may be the result of a methodological deficiency. For example, we faced the problem of whether the number of negative signs was more important in assessing the correctness of the desired pattern than the pattern which the encircled values assume. Although we strive for the lowest possible number of negative signs in a matrix, it is entirely possible to arrive at two *different* sequences which have an equal (or nearly equal) number of negative signs. Likewise, it is possible to have two *different* matrices whose encircled values have equally good patterns. These problems are made clear if we examine Figures 110, 111, and 112. Each matrix exhibits a different chronological order of sites — although possessing about the same totals of negative signs and having somewhat similar patterns for the encircled values. We chose Figure 112 as our final matrix because it most represented that which was considered to have the desired internal pattern. Actually, as we have seen, Figure 112 also exhibits the lowest *percentage* of negative differences. As we have pointed out, however, it is as yet methodologically impossible to determine whether the three percentages from Figures 110, 111, and 112 — and their respective encircled coefficients — differ significantly enough to determine which of them is the best. This method, it must be admitted, has a somewhat more subjective character than we would desire. Thus, our study would seem to indicate that additional work on the validity of the negative sign versus the encircled value would be in order.

On the other hand, it may very well be that the above problems may *not* be the result of methodological uncertainties but may be due to some conditions inherent in the primary data with which we are dealing. For example,

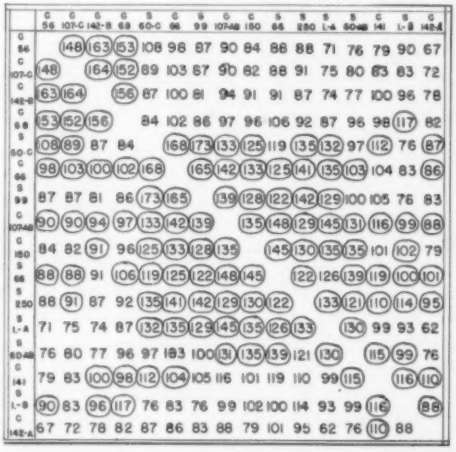


FIG. 112. This is the final matrix. It is the one which is considered to exhibit best the desired internal pattern. Percentage of negative differences is 15.2 per cent.

Figure 112 shows a rather curious (in respect to those in the Brainerd-Robinson report) arrangement of the agreement coefficients. Four "blocks" of sites are clearly discernible: 1) sites *C.56, C.107-C, C.142-B,* and *C.68* clump together; 2) sites *C.66* and *S.99* show a similar high agreement among themselves; 3) sites *C.107-AB, C.150, S.66, S.250-A, S.1-A,* and *S.60-AB* have similar agreement coefficients and stand out as a separate "block"; 4) sites *C.141, S.1-B,* and *C.142-A* may be termed "complacent" sites in that they appear to have neither very high nor very low values. These last three sites are, by the way, the most difficult to place in the matrix for this reason. The existence of these "blocks" introduces an element of doubt into the ordering since their presence suggests breaks in the smooth flow of culture change. Another factor which may be at work here, and likewise has to do with the data itself, is the problem of sampling errors. It is obvious that in a site with only a small number of associated artifacts, we may not be getting a representative sample of artifacts from it. This is an important problem because the agreement coefficients depend, of course, upon the relative percentages of artifacts in each site.

This whole question of "sampling" is, of course, one which presents itself in almost every statistical exercise from the very simple to the very complex. As the literature on this question adequately reveals, statisticians are by no means completely agreed on its solution (Hagood, 1941, pp. 404-433). Although a number of formulae have been proposed, it seems evident that nearly every new problem requires a different theoretical approach concerning the sampling question. Lehmer (1951), for example, criticizes Robinson's coefficient of agreement (pp. 7, 8) because "it takes no account of differences in the size of the collections." Lehmer then proposes a formula to calculate the standard error which, he says, will more accurately express the difference between any two collections. First of all, it should be noted that Brainerd and Robinson were *not* unaware of this question nor were they unaware of the formulae ordinarily used (Beals; Brainerd; Smith; 1945, pp. 164-168). Secondly, different problems require different approaches. A formula (such as Lehmer proposes) cannot be arbitrarily introduced into a mass of data until we know (1) exactly what the formula *should* accomplish and (2) whether the formula will so affect our initial data that any conclusions arising from it will be meaningless. If, for example, we use Lehmer's formula, it soon becomes evident that it is not at all useful for our particular problem; in fact, its use here would actually give a distorted and unreal picture of the culture sequences (cf. Robinson, and Brainerd, 1952, p. 60).

This lack, however, of an adequate formula to test the validity of each sample will not, in our opinion, affect to any great extent the results of this paper. Although we have reason to suspect that several of our sites may contain inadequate artifact samples *per se*, we have included them in our matrix because: 1) if we are to test Heizer's sequence, we must use as much of the material he utilized to form his sequences as is possible; and 2) the inclusion of the so-called "poorer" sites, as we shall later see, will not alter our conclusions, which, of course, are based on an *empirical*, not a theoretical, testing of the Brainerd-Robinson method.

If, on the other hand, we were to use this method for the establishment of a *new* cultural sequence — one which included previously unused data (Rozaire, n.d.) — the problem of choosing "reliable" sites would then be important. Archaeologists, of course, are nearly always faced with the problem of working with relatively small numbers of artifacts — especially non-pottery ones. Other things being equal, any statistical analysis should include those sites which contain a *minimum* of 50 (preferably 75) *artifacts*. While a culture sequence can be established with as few as three *types*, 6 or 7 good types would probably be considered a safe minimum — together with at least the same number of sites.

To conclude this rather inconclusive discussion of sampling, we must remember that archaeologists are usually not faced with the type of problem inherent in, let us say, poll-taking procedures. In the latter, one may quite easily obtain the necessary sample, or number of people (subject only to time and money), which will truly represent the total population. Unfortunately, this is usually not the case with archaeological materials where sample size is often, in reality, the *total* population (e.g. total number of all existing artifacts).

Four of our 16 sites contain fewer than 20 burials. Eight have fewer than 50 burials. Strictly speaking, then, if we were to follow the above "rules," at least half of our sites would have to be eliminated. As we mentioned before, however, we must use all of Heizer's material in order to check his sequence against ours. In the final discussion, moreover, special attention will be given to these "poorer" sites, since at least three of them have given us the most trouble in their placement in the matrix.

Aside from these various problems (which, of course, will ultimately have to be decided), let us turn to a discussion of how our results compare with those of Heizer. First of all, the chronological order of sites as exhibited by our final matrix (Fig. 112) agrees in most respects with that of Heizer (Fig. 114). In spite of the

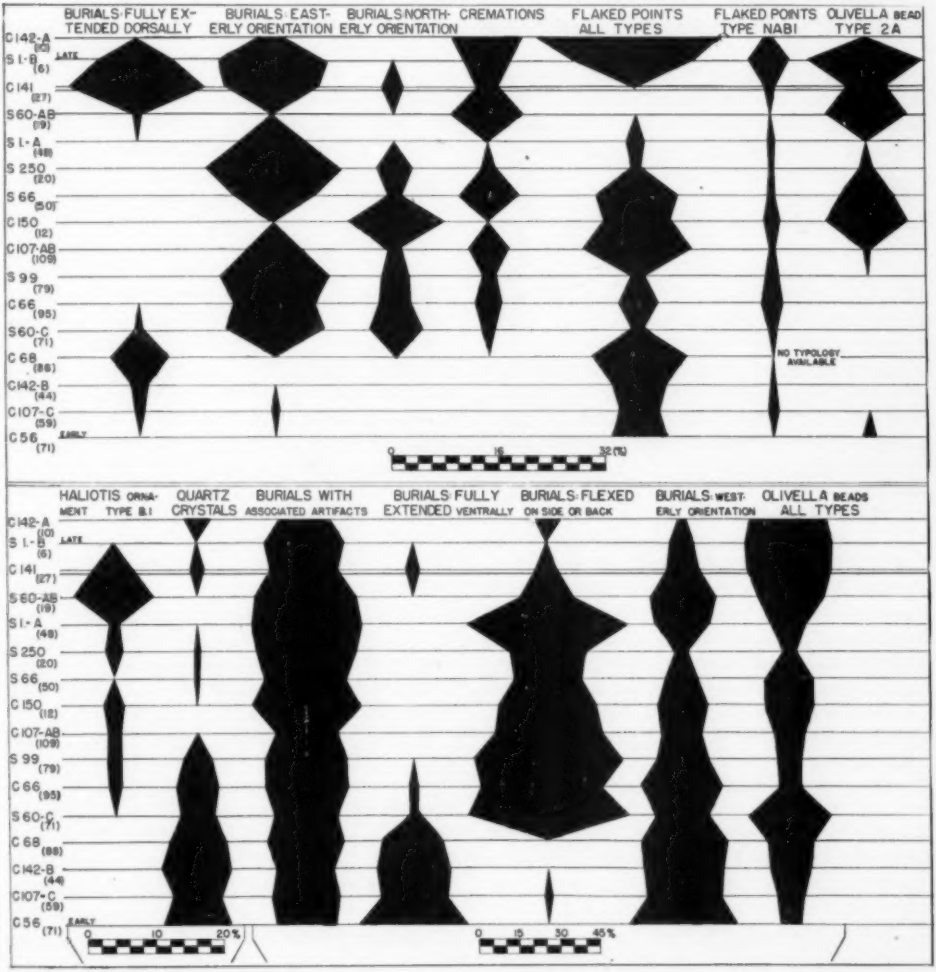


FIG. 113. The chronological order of the sites is taken from the final matrix (Figure 112). Under each site number is the number, in parentheses, of burials in the site. In each portion of this Figure there are three sites above a double line (*C.141*, *S.1-B*, and *C.142-A*) which are not included in the analysis of these "lenses."

several previously discussed methodological difficulties — together with some deficiencies in the primary data — the sequence obtained by the Brainerd-Robinson method is, in fact, in almost perfect agreement with that which Heizer has proposed! From an empirical standpoint, then, this method has acquitted itself well. Now this statement requires, we believe, some amplification and discussion, but before doing this it may be well to tie up a few loose ends.

A study of Figure 114 indicates that two sites (*C.141* and *C.142-A*) in our sequence fall into a different time horizon than they do in Heizer's. Our matrix shows both sites occurring in the late horizon while Heizer places them in the middle horizon. In *both* sequences, however, *C-141* is earlier than *C.142-A*. In addition, the two levels of site *S.1* are reversed in our sequence (the lower level, I appears later than the upper, II). Several reasons can be advanced to explain these differences — although, of course, these can be only of a tentative nature because of previously mentioned deficiencies in our method.

First of all, our three "troublesome" sites contain a relatively small number of burials (*C.141*—27; *C.142-A*—10; and *S.1-B*—6). The probability of these being inadequate samples is high. This may be the entire answer — or at least a major part of it. Ordinarily, as we explained before, these sites would not have been used in the first place.

Let us assume for the moment, however, that sites *C.141* and *C.142-A are* adequate samples. Is there any alternative answer, then, to the question of their being "out of place"? An investigation of Figures 110, 111, and 112 shows the several alternate positions which these two sites could assume in the sequence. As we noted previously, our method does not as yet permit us to decide accurately which of the three matrices best exhibits the desired pattern. We have chosen Figure 112, but the other two are quite "close." Interestingly enough, the "second best" matrix (Fig. 111) reveals that the position of site *C.141* here corresponds to Heizer's placement of this site. Similarly, our "third best" matrix (Fig. 110) shows that both sites *C.141* and *C.142-A* correspond to Heizer's placement of them. One possible answer, then, to the question we posed above is related to our present inability to choose between the three matrices. This difficulty, of course, may be more apparent than real. By this we mean that an alternate answer to this problem might be found in an examination of the *primary data* itself — rather than in the method by which we organize it. We suggested previously that these sites were complacent ones; that is, they contain neither very high nor very low measures of agreement. A type-by-type comparison of these two sites with all of the others shows the erratic behavior of the percentage of occurrence of various types among the former. In some types, for example, these sites compare closely with those of the early horizon; in others with the middle and late horizon; and in still others, with neither of these. These conditions suggest two possibilities: they are long term deposits in which progressive mixing has taken place (Cf. Brainerd, pp. 308-311); or, and as Heizer suggests (1939, p. 55), they may be local, independent specializations of the mortuary complex.

The above discussion indicates the aberrant nature of several sites and has included some suggestions as to why they are difficult to place accurately in our matrix. This is not to say, however, that we have encountered these problems because we had a reliable sequence at hand with which we could check ours. It is quite obvious that we would have had the same difficulties in working with previously unsequenced sites. In this case, however, we would either not use them to begin with (because the sample is too small), or if they were used, they would not have been included in the final matrix. It is expected, of course, that future work will point up ways of properly controlling the several variables which these two sites have shown to exist and thus allow a closer separation of variability due to time from that due to inadequate samples, social stratification, and regional variation.

At this point we would now be in a position tentatively to divide our sequence into time horizons and to attempt to define these horizons in terms of diagnostic artifact types. This, of course, has been done by Heizer (1939) and Beardsley (1948); and, since our sequence is nearly the same as theirs, we will not duplicate their efforts. If we did not already have this information, however, we would proceed in this manner: *first*, major time divisions could be roughly fixed by observing the grouping of agreement coefficients in our final matrix. On this basis, the early horizon would include sites

C.56, C.107-C, C.142-B, and C.68; the middle horizon: S.60-C, C.66, and S.99; the late horizon: C.107-AB, C.150, S.66, S.250, S.1-A, and S.60-AB. The last three sites, C.141, S.1B, and C.142-A, would not be included by reason of previous discussion. (These divisions are like Heizer's except that he would include sites C.107-AB and C.150 in the middle horizon.) We recognize, of course, that these clumpings merely suggest a technique by which we may group these sites into horizons. Actually, as we have noted before, the "blocks" may be influenced by factors other than chronological, i.e., sampling and site usage. Theoretically, then, the sites may be evenly spread through a time continuum. If *time* be the sole (or major) causative agent, however, these groupings of similar agreement coefficients will undoubtedly permit us to construct horizon zones and even, perhaps, allow us to assess relative time spans between the various sites studied. Experiments have shown, for example, that if we contour a matrix in which all of the sites are evenly spaced in time, the resulting contours will all be parallel to the diagonal. It follows that the extent to which these contours are *not* parallel is a function of differential time intervals between the sites. Although the details have yet to be worked out, the contouring of our final matrix (Fig. 112) and the subsequent process of "straightening" the contours out shows that there are about five "units of time" separating the first four (early) sites from the fifth site (C.68). Similarly, there are "four and one half units of time" between the fifth site and the sixth. The sixth site (C.66) and the thirteenth site (*S.60-AB*) are separated by "nine units of time" and the last three by "six units" (Cf. Brainerd, 1951, p. 310). *Secondly*, the diagnostic types for each horizon could be obtained from Figure 113. Here the sites as ordered by Figure 112 are laid off on the vertical axis, and the percentage of each type is plotted on a horizontal axis. We have seen that a type will assume a lenticular shape if: 1) it has been correctly ordered on the matrix, 2) time is the only factor influencing the chronology, and 3) we assume to have obtained a representative sample of the type for all the sites in which it occurred. Since we have already discussed these three items, let us examine Figure 113 to see whether our types approach the desired lenticular patterns. At first glance, the "lenses" are not quite what we would expect them to be — especially if we compare them with Brainerd's results (1951, pp. 300, 306). We may suppose, however, that, other things being equal, one is able to control more closely the three above variables (especially *2* and 3) when working with purely ceramic types than with nonceramic ones. In any case, we can observe some regularity upon a closer inspection of our graphs, and we suggest that the following conclusions may be drawn from them (sites C.*141*, *S.1-B*, and C.*142-A* are excluded from this discussion): 1) the type, "burials with associated artifacts," shows little or no lenticular pattern and thus cannot be considered a diagnostic type for any horizon. 2) the types,

	C142-A	S1-A
	S1-B	S60-AB
	C141	S1-B LATE
	S60-AB	S250
LATE	S1-A	S66
	S250	
	S66	C150
	C150	C142-A
	C107-AB	C107-AB
		S99 MIDDLE
	S99	C66
MIDDLE	C66	C141
	S60-C	S60-C
	C68	C68
EARLY	C142-B	C142-B EARLY
	C107-C	C107-C
	C56	C56

FIG. 114. This compares the sequence resulting from the final matrix (on the left) with that of Heizer (1949, p. 2). See text for discussion of the aberrant nature of the last three sites.

"burials: fully extended ventrally" and "burials: fully extended dorsally," are both apparently diagnostic of the early and early-middle horizons. The existence of the latter type, however, in the late horizon site (*C.60-AB*) presents a problem, the solution of which allows of several equally possible explanations. If our chronological ordering is correct, then this situation is a result of the presence of certain factors other than time, the type in question may have been present but not as yet found, or extended dorsal burials may not constitute a true type as the word is defined above. We are inclined toward this latter view since, after all, there are only a very limited number of ways in which a person can be buried. 3) the type, "burials: flexed on side or back" occurs in the middle and late horizons almost exclusively. It is interesting to note here that site *S.60-AB* shows a decline in the percentage of this type, while — as we have just seen — *extended* burials are apparently reintroduced. 4) the types, "burials: westerly, easterly, and northerly," show some regularity — especially the first, where the type is numerous in the early sites and apparently is declining in the late. At this point, one might well ask: how do we know whether or not these graphs are statistically significant? That is, if a typological ordering does not show a clear lenticular pattern, how can we determine whether this ordering is other than a random distribution? Unfortunately, the test for randomness suggested by Robinson (1951, p. 301) did not work on this material. After several attempts, it was apparent that this test (Wallis and Moore, 1941, pp. 401-409) was "insensitive" to our material. It also failed to consider the relative frequency of the type as it passed through time. A more suitable test is now being worked on. While we are thus not yet in a position to verify the accuracy of sampling in our graphs statistically, we can be sure that if two or three of them are obviously significant, then a large percentage of the "borderline cases" will not be merely random orderings. These, then, are some of the problems encountered in analyzing the graphic results of a typological ordering of the final matrix. Using the above-mentioned techniques, we are thus able to divide most of our types into several categories: a) those which are clearly diagnostic of certain time horizons; they will usually show a good lenticular pattern; b) those which indicate that some agent, other than time, is affecting its order. This might be shown by 1) a break in the lens (see "quartz crystals," Figure 113) or by 2) widely fluctuating frequencies (see "burials: easterly orientation"). The *former* condition (in "b"), in most cases, will probably be the result of outside influence on the site — trade, immigration, or a general diffusion of ideas; the *latter* condition (in *2*) if it is not the result of random ordering, probably indicates an insufficient sample of the type in question; and c) types which show little change through the entire sequence.

In summary, then, we believe that the results of this paper have been, on the whole, successful. The close correspondence between the two sequences can leave no doubt that the Brainerd-Robinson method is a useful tool in the chronological ordering of archaeological deposits. The empirical testing of this method has indicated, moreover, that it is sensitive to certain conditions which might be said to be a by-product of the over-all chronological pattern. For example, Heizer reports that "there is . . . some evidence of an appreciable time hiatus between Early and Middle period occupancy of the lower Sacramento Valley" (Heizer, 1941, p. 39). This shows up clearly on our matrix as a disjunction between the first and second "blocks" of sites. On the other hand, we have seen that this method has revealed the presence of certain nontemporal factors — factors which Heizer also noticed. The evidence which points to these factors is, we repeat, of a negative kind; for if our final matrix does not assume the desired internal pattern and the types do not exhibit lenticular patterns, then — if we discount possible working errors — our hypothesis (that *time* is the only agent affecting the ordering of our sites) is wrong. We may then assume that nontemporal factors are present. The negative aspects of this method, thus, may indeed contribute as much to the solving of various archaeological and ethnological problems as will the positive ones. Further, we have indicated some of the problems arising from this study, in some cases offering some suggestions as to their solutions, in others pointing up the need for further investigation. Lastly, we wish to point out that, of course, the successful application of this method does not *in itself* prove the correctness of Heizer's sequence; it merely *confirms* the results which he has obtained by other means. It seems quite evident that a competent worker — especially

if he is dealing with a relatively small number of sites and artifacts — will probably come to about the same conclusions using regular techniques as he would if he utilized *this* method. The advantages of the statistical approach will multiply as the data become more complex and the various inspectional methods are thus often difficult to control adequately. In addition, its further refinement will no doubt permit us to determine accurately the effects of regional variations, disjunctions, and nonchronological influences, the answers to which are always important in any archaeological analysis of culture.

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University of California
Los Angeles, California
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THE PRESENT STATUS OF CHEMICAL METHODS FOR DATING PREHISTORIC BONE

S. F. Cook and R. F. Heizer

IT IS NOW OVER half a century since Carnot (1893) published his pioneer work dealing with the chemical analysis of fossil bone. In the intervening decades the problem has been investigated by occasional students who have approached the field from different directions. Recently interest in chemical methods has been intensified, and the attention of archaeologists has been brought to a focus by the attempt of Oakley (1951) to utilize the fluorine content of human bones as a criterion of age. Also during the past few years a joint project has been pursued by the Departments of Anthropology and Physiology at the University of California (Berkeley) through the generosity of the Wenner-Gren Foundation for Anthropological Research. Thus a considerable effort has been expended, and a reasonable volume of results are on record, with reference to the chemical changes which occur in fossil bone. At the present time it appears that a general survey of this work is in order, together with an appraisal of its value as a tool for the archaeologist and palaeontologist. Fairly comprehensive listings of published works on the subject of bone fossilization occur in Heizer (1950, 1952).

Study of the chemistry of fossil bone in the past has been undertaken with two objectives in mind. The first is purely scientific curiosity as to the nature of the process of fossilization; what happens to the bone during its burial in the earth, and why. Contributions can thereby be made to problems of interest to the physicist, the chemist, the mineralogist and the soil scientist. The second objective has been to discover a method whereby the age in years of any given osteological specimen could be determined. The latter ambition has of course been of primary concern to the prehistorian, and it is this matter of archaeological dating which we wish to discuss briefly.

Fundamentally there are two methods of dating, one of which has been used effectively by Oakley, but which has rigid limitations, the other of which has been the goal of most investigations of fossil bone. The first method is that whereby the unknown bone specimen is compared, with respect to some particular component, with another bone, the date of which can be more or less securely established. If the substance is contained by the two bones in equal amount, within a reasonable margin of error, they are considered contemporaneous. Otherwise one is older or younger than the other, depending upon the relative quantities involved. Naturally the test substance must be one which is known to increase or decrease in fossil bone throughout a pertinent time interval. This method is rational and accurate but demands first that a bone be found with which the unknown can be compared and secondly that it be derived from exactly the same stratigraphic horizon as the bone under investigation. These conditions are frequently very difficult to satisfy.

Nevertheless Oakley has made important contributions to our ideas concerning the age of such critical material as the remains of the Piltdown, Galley Hill, Fontechevade, Rhodesian and other Pleistocene hominids. His method has rested upon the discovery made in the nineteenth century that animal bone, lying in the ground, accumulates fluorine and incorporates the element into the crystal structure with the formation of fluorapatite. Unfortunately the rate of accumulation is a function not only of time but also of the fluorine concentration of the soil in which the bone is buried, and since the fluorine content of all soils varies widely no generally applicable quantitative scale for assessing age is possible (Heizer and Cook, 1952; Oakley, 1952).

The only other element which has been treated in a similar manner is uranium, the occurrence of which in fossil bone is the subject of an interesting paper by Jaffe and Sherwood (1951). They analyzed shark and manatee bones from recent age as far back as the Tertiary Period and found a clear tendency toward accumulation of this element. It has not yet been determined whether during the short span of archaeological time a sufficient change takes place in uranium content to be detected by existing methods. Moreover it is probable that the uranium concentration from soil to soil varies in a manner similar to fluorine. The same objection will undoubtedly have to be raised against the use of any other of a number of elements (particularly iron and

silica) which are known to be present in most soils and in some fossil bones. If the trace element method must depend upon the penetration of a foreign material into the bone as it lies buried, we will always be confronted with the unfortunate fact that no two soils anywhere on the earth are absolutely identical, and, that, therefore, the penetration rate of a certain element can never be quite the same into two different bones. The investigator is consequently foredoomed to the restrictions which have limited the work of Oakley and have forced him to operate only with pairs of bones, the two members of each of which are taken from soils as nearly identical as possible.

The second method is the one toward the perfection of which most investigators have striven. It is based upon the hope that some chemical change goes on during the fossilization of the bone which is totally independent of external conditions and which therefore always proceeds at the same rate regardless of where the bone is located. Given such a process, a pilot series of analyses could establish sufficient points on the curve, the half-life could be calculated and the age of any fossil bone could be determined within the accuracy of the experimental method. It is exactly such an alteration in the radioactive decay of carbon[14] which has provided us the best long-range archaeological dating scheme yet discovered. This latter, however, is not a chemical process in the analytical sense, and furthermore is not applicable to bone (Libby, 1952).

The primary constituents of bone are of two categories, inorganic and organic. The inorganic fraction consists almost entirely of calcium, phosphate and carbonate, together with a little magnesium and traces of other compounds or elements. The organic portion of newly killed bone is made up principally of protein, fat, perhaps a little carbohydrate and considerable bound water. There is consequently no lack of materials to be traced during fossilization. Certain difficulties have been encountered, however, in the study of all of them, difficulties which appear to be inherent in the basic approach rather than peculiar to any of the component substances (Cook and Heizer, 1952).

One rather technical but still important obstacle to the application of the chemical method is the necessity of finding a sufficient number of samples. If, as we have done in our laboratory, one analyzes a series of bones from a single skeleton (Heizer and Cook, 1949), or a group of anatomically similar bones gathered from the same site and stratigraphic horizon, he will find a high level of variance with respect to any osseous component which has yet been studied. This variance is such that even with twenty to thirty, or even more, samples the standard deviation will amount to anywhere from ten to fifty per cent of the mean. It follows therefore that if one wishes to compare two single bones of different age, or two small groups of such bones, the spread between the means (or the individual values) must be really impressive if any significance is to be attached to the results. Unfortunately a great deal of the work in the past has been carried out with such limited series of samples as to have detracted seriously from the value of the investigations.

This inevitable individual variation can be referred to a number of causes. A very small portion is attributable to experimental error in the sense of minor fluctuation in analytical procedure from bone to bone, but with good modern methods this fraction is negligible. Another source of variation is actual difference in composition from one part of a bone to another, or from one bone to another. But this difficulty can be avoided by selecting the same portion of the same bone for each analysis, for instance by always using the middle of the shaft of the femur, or some other long bone. Nevertheless even when all controllable variation has been reduced to a minimum a great deal still remains and this variation must be regarded as due to factors present in the soil and operative during the period of fossilization (Cook and Heizer, n.d.).

The normal mineral constituents of bone are of course calcium phosphate and calcium carbonate combined in the form of the apatite structure. During prolonged interment the relative quantities per unit weight of bone of the three primary analyzable components, elementary calcium, phosphate and carbonate, characteristically undergo very great alteration. Usually there is an increase in all these substances, expressed in per cent by weight, due to the progressive loss of the organic matter. Frequently there is a particularly sharp increase in carbonate such as was noticed, for example by Carnot (1893), Barber (1939) and Cook (1951). It has generally been considered, with reference to bones of this sort, that the

carbonate was accumulated by precipitation from soil solution during burial. Furthermore it has been suggested that such accumulation was not only a normal but even an inevitable accompaniment to the process of fossilization.

In our investigation, however, we have found the mean values for carbonate content of bone series from different sites to vary within wide limits (Cook, 1951). Although in the California series there has been a marked tendency for the older bones to contain a higher per cent of carbonate, any attempt to establish this tendency as a universal generalization is immediately nullified by the exceptional data for a few sites. Thus four sites of the Early cultural period in the Central Valley show mean carbonate percentages ranging from 5.62 to 9.67. Site LAn-1, on the southern California coast, and of undoubtedly early cultural affiliations (Treganza and Malamud, 1950), contains bones with an average carbonate content (expressed as carbon dioxide) of 2.50 per cent, a value much lower than is found in normal fresh bone, whereas the carbonate content of bones from site SBa-7, of Oak Grove culture, and possibly somewhere near the age of LAn-1, is 6.51 per cent. These examples are mentioned because they are familiar to us. Numerous others could be found in the literature.

What is true of carbonate is likewise true of calcium and of phosphate. Some bones show a heavy accumulation, some little change and some even a loss, despite the fact that if a great many bones are studied, from a wide range of localities, there is a trend toward increasing quantities of all three components with age.

These discrepancies, which are the basis of the inherent variation seen in the analytical results, are due to interchange of substance between the bone and the surrounding soil solution. We were able to demonstrate (Cook, 1951) by the use of carbon^{14} and phosphorous^{32} that tracer quantities of both carbonate and phosphate can be readily accumulated or equally easily eliminated by ground-up samples of fossil bone within a matter of minutes, or in some cases seconds. Allowing for the greater quantities involved and the longer distances through which penetration must take place in whole skeletons, our results indicate that archaeological time periods are quite adequate to account for all observed alterations in the inorganic composition of fossil bone for it is highly probable that the chemical equilibrium between the bone and the surrounding soil solution is established extremely rapidly.

It follows from these considerations that when we analyze a fossil bone for any inorganic component which is even slightly soluble in water, we are indirectly measuring the existing relative concentration of that component in the soil matrix. Since this is true for the present moment, it must likewise be true for any past moment, and indeed the composition of the bone as we now find it represents the sum total of the chemical changes which have occurred in the soil of the site since the bone was first interred.

Every archaeological site, whether a "natural" soil horizon, or whether derived from habitation midden, has its own distinctive, individual character which is the resultant of all the physical, chemical and climatic influences brought to bear throughout its history upon the original material which formed the site itself. No two sites are composed of exactly the same substance. No two sites are subject to completely identical physical, biological or meteorological processes for exactly the same length of time. Therefore the chemical history of every site as we encounter it differs in some regard from that of every other site and consequently the bones buried therein must of necessity be different with respect to the inorganic constituents. This fact can not be overemphasized. It is the very core of the obstacle to the chemical method of dating. It presents a problem which admits of but two possible solutions: 1), to ignore the great variability in composition induced by chemical soil differences and thereby sacrifice all claim to even a reasonable accuracy of method, or; 2), to conduct exhaustive analyses of the site mass as well as of the bones, not only as at present constituted, but also from the standpoint of past history. The second alternative obviously would require an enormous outlay of skill, time, labor and funds.

A superficially attractive detour around the difficulty is the almost universal observation that, regardless of the variation in the composition of the mineral fraction of fossil bone, the organic portion tends to diminish and ultimately disappear with advancing age. Moreover it is generally conceded that organic compounds in the bone do not *interchange* with soil constituents as do inorganic elements and

ions. There is some possibility therefore that the total organic fraction, or certain specific organic substances, decompose in a manner and at a rate which is *independent* of soil conditions. A number of investigators have pursued this line of attack.

Gangl (1936) investigated the fat content of fossil bone and concluded that there was a progressive reduction with time. His known dates, however, failed to correspond satisfactorily with the fat content of the bones. Barber (1939) noticed that the total nitrogen content of his older bones, reaching back as far as the pliocene, was much less than that of his more recent material. However, he analyzed only single samples (a total of 25 in all) from each horizon and age. Hence he could do no more than establish a probable trend. Pin (1950) observed a similar reduction in nitrogen. Thunberg (1947) examined a series of recent and prehistoric bones and analyzed their citric acid content. His data show very well the type of result which has been obtained by him and also by other investigators. The following list is taken from his tables.

Species	*Approximate age in years B.P.*	*Citric acid content in parts per million*
cattle	400	2,200
"	"	3,400
man	600	700
"	"	800
horse	700	6,600
"	"	9,300
man	750	9,000
man	1,500	1,600
man	4,000	100
man	7,500	200

It would be truly difficult if one obtained a value of, say, 500 parts per million of citric acid in a single fossil human bone to state where, between 600 and 7,500 years B.P., its true age lay. These discrepancies have been recognized by Thunberg who clearly states that citric acid is not a criterion of value for determination of age.

Perhaps the most extensive investigation of organic content in fossil bone has been that carried out in the Berkeley laboratory. We have determined the organic carbon and the organic nitrogen in nearly 600 fossil human femurs, including approximately 35 series of samples from different sites (Cook and Heizer, 1952). More recently we have been able to estimate the constituent amino acids in fossil bone proteins by means of paper chromatography (unpublished data) and have been able to show that in bones of the earliest cultural period in Central California the chemical composition of the original bone protein has remained unchanged. There can be not the slightest question that there is a slow, progressive loss of organic matter from fossil bone, without apparent chemical alteration and that this process requires many thousand years for its completion. And yet, just as with Gangl or Thunberg, our values for carbon, for nitrogen, and even for amino acids show serious divergencies and discrepancies. It is abundantly clear that whether the same factors are concerned as may be the case with inorganic substances, the decomposition of organic matter in bone is *not* independent of external physical and chemical conditions. Therefore a simple, unequivocal dating system can not be based upon the analyses which we now have for the organic constituents of fossil bone.

The difficulty derives really from our fundamental ignorance of the precise processes which unfold themselves during fossilization. There has been clearly established a differential removal of organic matter, including fat, citric acid, protein, carbon, nitrogen and probably a host of other materials. The uniformly discordant results are clear evidence that the course of the removal proceeds at different *rates*. After all none of us can observe more than the terminal state of the bone. There is no clue as yet uncovered which gives us an indication of the rate at which this state has been achieved. To be sure we can hypothesize on reasonable grounds that the decomposition of the organic matter is an exponential function of time and from some of the graphs we can even postulate that there are at least two components, one fast and the other slow. But we have no tangible data pertaining to the actual nature of these reactions. All we can do is to project the present state backward into the past and such a *modus operandi* is certain to lead us to false conclusions with respect to individual dates. The basic trouble is that at the moment we have only the most naive of empirical methods. We lack a sound theory upon which to erect a system for dating.

We do not wish to appear unduly pessimistic nor to advance the opinion that a satisfactory chemical method of dating can not be found. Nor do we wish to deprecate the expenditure of time and effort which has already been made on the problem. The investigations to date were essential in order to discover and define clearly the intrinsic limitations and obstacles to the method. It is now incumbent upon those scientists interested to decide whether further research should be devoted to the objective of chemical dating, and, if so, in what direction and to what extent it should be prosecuted.

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THE EXCAVATION AND HISTORICAL IDENTIFICATION OF A HURON OSSUARY*

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THE UNUSUAL OPPORTUNITY of excavating a Huron ossuary presented itself to the Royal Ontario Museum of Archaeology in 1946. The fact that probably less than a half dozen such sites still remain, coupled with the possibility that the ossuary in question was the one which the French Jesuit, Jean de Brebeuf, saw in use in 1636, led the Museum to decide upon excavation. A special grant from the Province to the Museum for archaeological purposes enabled work to begin.**

The site was situated on a small sandy plain about one hundred acres in extent (Fig. 115), on the farm of Mr. Charles Daoust, in the north half of lot 14, concession 7, Tiny township, Simcoe county. The nearest stream is one-half mile to the west. Remains of historic Huron villages lie one mile north and one and one-half miles northwest of the site. When first seen by the writer, the ossuary was visible as a broad, saucer-shaped depression in the ground, whose maximum depth was about two feet, with a slightly elevated rim marking its borders. The owner said that he had long known the place for what it was, since he had once attempted to bury a sheep in it, but he believed it had not previously been disturbed. After finding human bones, and recovering them, he had not again touched the pit (Fig. 116).

The purpose of this paper is to present briefly data on the nature of the ossuary itself, together with an account of its grave furniture and its possible historical connection. While such information was relatively easy to glean, the case is far different with the osteological material. This great mass — perhaps the largest amount of its kind ever to be recovered in eastern North America — presents a multitude of problems, the solution of which will require many years of labor. Reports upon this aspect of the research will, it is hoped, be published from time to time as soon as they are prepared. Meanwhile, it seems desirable to place before interested readers without further delay those details of the ossuary which are already known so that its archaeological and historical position will be assimilated.[1]

Beyond those having to do with surveying, handling tools properly and taking the customary care of specimens, the usual procedures for excavation do not altogether apply when it comes to excavating an ossuary. Work upon this one was begun by laying out the surrounding half acre in five foot squares. Contours were noted and excavation by 3 inch levels was begun. Photographs, profiles and square plans were made wherever necessary; the locations of artifacts were accurately noted, and the objects removed with all possible care, cleaned, catalogued, and packed for shipping. The skeletal material, however, was subject to no rules. Long bones, for instance, lay in all positions and at all angles; a single femur, standing on end might traverse five levels, while crania occupied at least two or three levels. Furthermore, because of interlocking, material frequently could not be extricated until several days' work had been done to release it, thus making the maintenance of levels difficult or impossible (Fig. 117, *a-c*). The only consistently applicable procedure to follow under the circumstances was to proceed with

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** In the early summer of 1947 the Museum began the task, under the direction of the writer, and with the assistance of a number of students from the University of Toronto. The town of Midland supplied a truck and living accommodations for one season. Frank Ridley, the discoverer of the site and Gerald Fair, then of Alliance Paper Mills, lent invaluable help. In 1948 the work was carried to a successful conclusion with Museum funds and with the generous assistance of a gift from David Walker, Esq., K. C. The aid of all those who helped with the work, although they cannot each be mentioned individually, is gratefully acknowledged.

[1] The author is deeply indebted to the following for their assistance: H. Brown, Brown University (information on the Place Royale); V. B. Meen, Director of the Royal Ontario Museum of Mineralogy, Toronto (minerals); F. F. Morwick, Department of Soils, Ontario Agricultural College, Guelph (soil analysis); H. Rehder, United States National Museum (shells); J. S. Roberts, Department of Household Science, University of Toronto (textile fabrics), and F. A. Urquhart, Director of the Royal Ontario Museum of Zoology, Toronto (insect remains).

all reasonable care and to record data as consistently as conditions permitted.

Results were remarkably gratifying. Data were recorded upon the size, construction and shape of the pit, and upon the amount and origin of the grave furniture. A vast quantity of osteological material was successfully removed and made available for study as already noted. The amount of breakage was negligible, despite the utter disorder and confusion in which the bones were found.

The exploratory work on the surface of the field around the pit revealed little disturbance of the soil other than by ploughing, and only a few flakes of chert, vestiges of fire and other cultural evidences.

Between 10 and 15 feet west of the ossuary an early excavation about 5 feet wide was encountered. It was followed down 4 feet to the bottom and found to contain only the femur and bones of one human foot, clearly indicating that it had been a temporary grave. The contents may have been, and very likely were, removed to the ossuary by the Hurons but this is not easy to prove.

The ossuary (Fig. 118) was not spectacular in appearance. The slight elevation around the rim of the pit was not more than from four to six inches high, yet was plainly visible. Examination by sectioning revealed that it consisted of yellow sand exactly similar to the field subsoil, capped with about an inch of recent humus. The conclusion is apparent that this small, irregular ring of sand was left, doubtless unintentionally, when the pit was filled in, or by the subsidence of the pit surface, and had never been more prominent than when excavation began.

Exploratory work brought to light the presence of numerous post molds immediately surrounding the ossuary, but not present further afield (Fig. 118). The individual posts varied

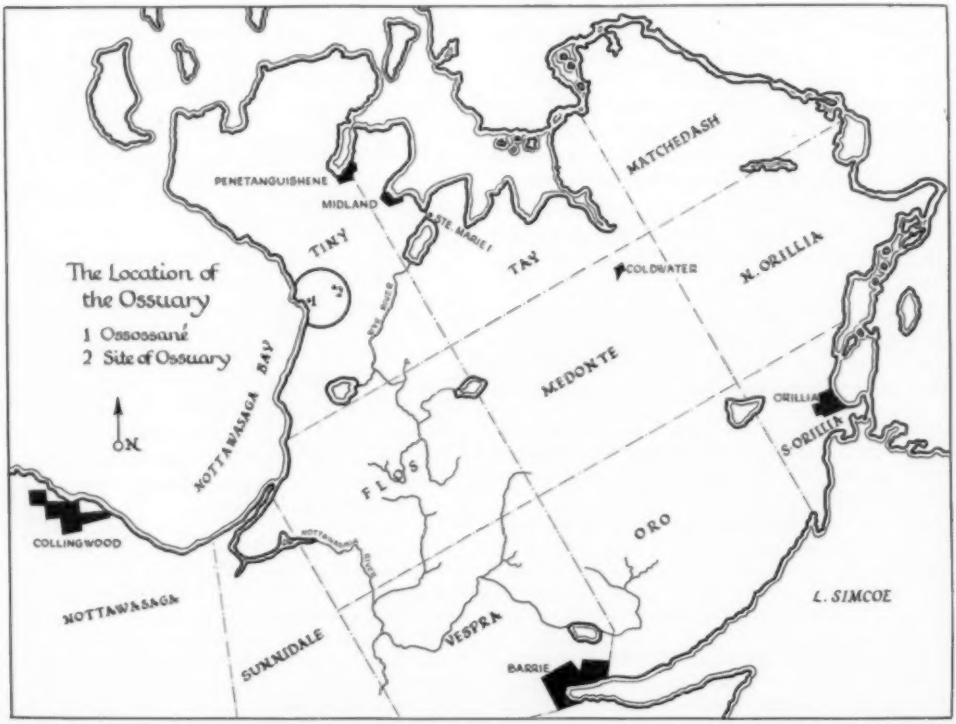

FIG. 115. Map to show location of the ossuary in Tiny township, Simcoe county. In the circled area, the supposed village site of Ossossane is at 1 and the ossuary at 2. Scale: about 3/10 of an inch to the mile.

from 6 inches to 1 foot in diameter, and averaged 9 inches. They were set in the ground to a depth of from 1 to 1½ feet and were frequently supported by smaller braces set at an angle to the upright member. The diameter of the area covered by these was about 55 feet, centering in the pit. As will be seen below it was customary for the Huron to set up a scaffolding around their ossuaries for ceremonial purposes (Fig. 119), and there is also the suggestion that they erected a sort of grave house over them. The post molds described above are almost certainly the remains of the scaffolding, though some may also pertain to a grave house. Unfortunately, the arrangement is lacking in any pattern except that there seems to be a circle of rather larger than average posts near the perimeter of the depression.

The ossuary was bowl-shaped with a more or less flat, but not perfectly level bottom (Fig. 120). The diameter of the pit from rim-crest to rim-crest was 24 feet; that of the bone mass contained within it, 5 feet less. The depth below the rim varied between 5 and 6 feet, but since the pit was dug on slightly elevated ground, the bottom was somewhat less than this depth below the level of the field. The overburden was far from homogeneous, for it contained quantities of charred wood and sticks, much of which appeared to be of rather recent origin, and parts of the skeleton of a horse. Little pockets of fragmented human bones in the overburden proved earlier disturbances on a minor scale. As may readily be understood in the light of the historical accounts of ossuary ceremonies, the mass of bones was irregular, being deeper in some places and shallower in others. Generally, its thickness was about 2 feet, and most of the bones were surrounded by sand which had filtered down from above. In a surprisingly large number of cases, however, there were pockets into which no sand had penetrated.

The soil on the sides of the pit was generally slightly darkened while on the bottom there was from 1 to 3 inches of a black, mucilaginous humus, filtered out from the decaying organic matter which percolated from above. Samples of the (1) field sand, collected at a distance from the ossuary, (2) sand from the little lenses or pockets among the bones, (3)

FIG. 116. A view of the ossuary before excavation, from the east.

humus at the base of the ossuary and (4) sand from below this were tested for acidity and for phosphorus content, the results of which are presented in the tabulation which follows. The samples are arranged in the same order as they are mentioned above, and the conventional notations used. The pH content was determined by the glass electrode method; the phosphorus by an extraction of the material using KHSO buffered at a pH of 2.0; carbon by ingestion with chromic acid and the organic matter calculated from the per cent carbon multiplied by 1.724.

Sample number	pH	p	%C	%O.M.
1.	6.15	33 p.p.m.	.235	.41
2.	5.39	97	.46	.79
3.	5.97	1690	6.78	11.69
4.	6.67	504	.20	.345

The analyst remarks:

The organic matter in the surface soil is variable depending on the way the soil has been managed, usually being high in the surface layer in comparison with lower depths. This surface soil seems to be somewhat lower than the average for sandy soils, but then, of course, there may have been comparatively little vegetation growing at this site. Sample No. 3, of course, is quite high and compares generally with the high phosphate content in that same sample (Morwick, personal communication).

The outstanding feature is obviously the high phosphorus, carbon and organic content of sample 3 from the bottom of the pit, compared with those from above it; it is generally less acid, however, than material from higher and lower levels. The fourth sample, from beneath the bottom of the pit, is more acid than any other, and has a higher concentra-

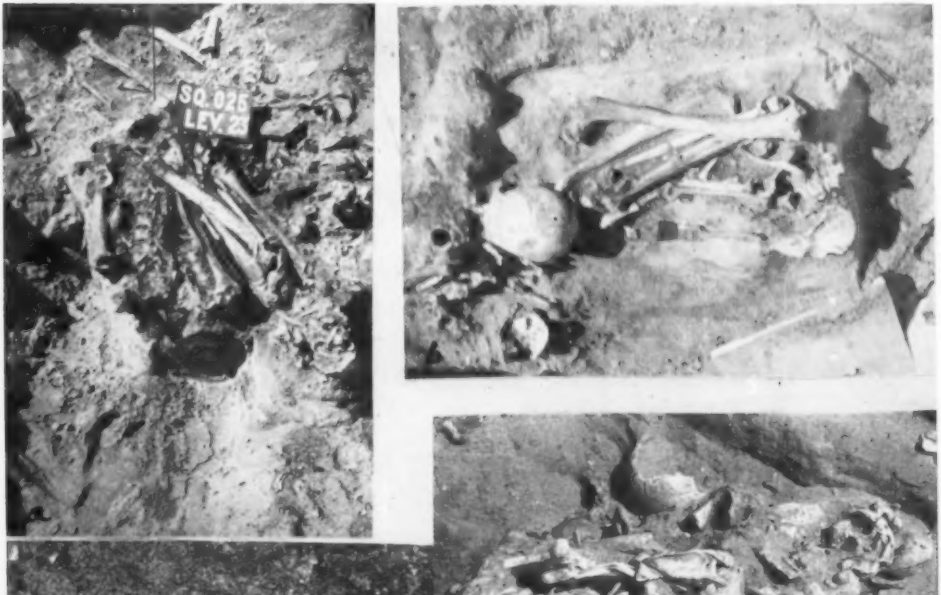

FIG. 117. *a-c.* Three details of the excavation of osteological material. *d.* Fragment of a shell ornament *in situ*.

tion of phosphorus than ordinary, since these compounds have leached through the sand at the base of the pit; but the sample is lower in carbon and organic matter, these having been caught and retained by the same sand layer. Further research upon the question of leaching of the phosphorus from the bones might be profitable.

Early in the excavation work, two bundle burials were encountered. The first lay at a depth of 40 inches, at the south edge of the ossuary in a small pocket of the pit wall. This pocket had apparently been especially dug out to receive the tightly flexed remains of a young adult, with the hands under the chin. The head was at the east and faced upward, the legs to the south (Fig. 121). The second bundle lay beneath the first; it also was tightly flexed with the knees under the chin and was placed on its right side. Since the mandible was nearly edentulate, this appeared to be the skeleton of an old individual, probably male.

There was evidence for bundle burials elsewhere in the pit, though no other case was so clearly delineated. Groups of long bones were frequently found lying in close contact and parallel with each other, numerous examples of which came to light around the sides of the ossuary, and more particularly at lower levels where less subsidence had occurred to cause dislocation. These peripheral bundles had the appearance of having been laid in on end, so that the long bones were in a more or less upright position, much as one might set bundles of sticks on end around the walls of an excavation. But due to the proximity of such groups it was not possible to isolate them according to their original owners. To do so would have required much time and the services of an expert anatomist. In many instances groups of bones were found to be surrounded by a fibrous material which we take to be the remains of bundle wrappings.

Two extended burials had been made on the floor of the ossuary, one of which was that of a young woman. She probably died in childbirth, for the skeleton of a very young infant lay in the region of the pelvic cavity. Extraordinarily enough, the lower portions of the woman's skeleton were placed ventral side uppermost, but the part above the pelvic girdle lay in the opposite position. The other burial lay close by but appeared to be incomplete, although there is a possibility that some of the bones were unwittingly removed along with the overburden.

All but a very few of the crania were either completely fragmented or badly damaged. About 25 were preserved in a sufficiently good condition to be immediately useful to the physical anthropologist, but of these, only two retained the mandible.

The extended burials presented the greatest possibility of recovering a complete skeleton offered by the pit material. Bundle burials, being secondary interments, were seldom if ever complete to begin with. The remainder of the bones in the ossuary lay in extreme miscegenation, best exemplified perhaps by crania lying inside pelvic cavities, ribs perforating eye sockets and by one case in which four or five vertebral columns lay side by side in the most inexplicable association. Under such circumstances, hope of recovering entire skeletons was almost *nil* (Fig. 117, *a-c*).

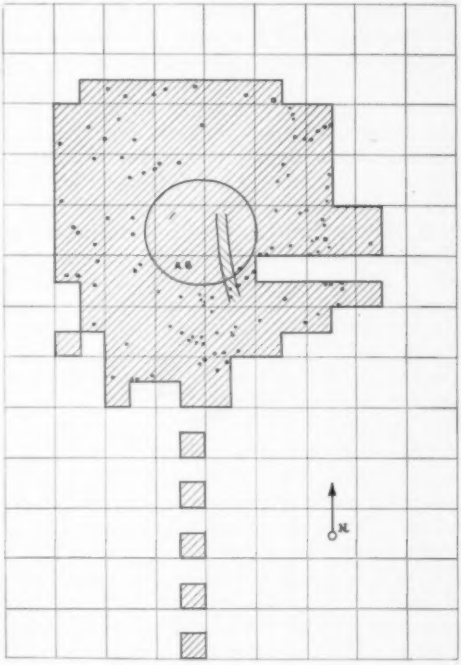

FIG. 118. Plan of the excavation. The excavated area is indicated by hatching, the ossuary by a circle. A test trench is shown by two parallel lines and bundle burials indicated at A and B. Black dots represent post molds. One side of a square represents five feet.

Unfortunately for anthropometric purposes, many bones and particularly long bones were broken. Such a state of affairs is not difficult to understand when one remembers that the bones were thrown in originally, and that the later settling of the soil above would affect them. Moreover, erosion had taken its toll, particularly upon the ends of long bones, the pelvic girdle, the lower mandibles and many crania. Foot and hand bones seemed to suffer least from this factor. Despite the above-mentioned conditions, the amount of useful material successfully removed from the pit was large. The amount of breakage occurring during the excavation was negligible, despite the difficulties. In addition to the osseous remains, several locks of human hair were obtained.

Judging by the volume of the bone mass, it would appear that the pit must have contained close to 1000 skeletons; however, no count has yet been made to ascertain the exact number.

Artifacts occurred throughout the ossuary. The friends of the deceased Huron had presented them at the time of this secondary burial with numerous gifts for their use in the afterworld. Most of these appear to have been either for personal use or for adornment; but some, like the kettle, may have been intended for the communal use of the dead. This, however, is a point upon which further information is necessary. As between goods of native manufacture and those of European origin, no distinction seems to have been drawn; both were deposited freely and in about equal amounts. Presumably one was as acceptable to the dead as the other, just as they were both useful to the living, and it would appear that certain rare objects were deemed to possess the same prestige values in the spirit world as in the present.

Grave furniture of aboriginal origin was not varied. The more numerous articles were objects of shell, chiefly in the form of beads, followed by stone projectile points, pigments, textile fabrics and pipes.

One large conch shell (*Busycon contrarium* [Conrad]) lay at the southern rim of the pit near the bottom, in association with bones, but there was nothing to tell to which remains it belonged. Its condition was remarkably good and the only manner in which it had been purposely altered was in the removal of a section 4 by 9 cms. from the exterior wall of the large end (Fig. 122). Thirteen *Olivella* shells were found elsewhere in close enough association to permit one to assume that they had been strung together (Fig. 123, *m*). All parts of the ossuary contained beads of several sizes and shapes made from the columellae of conch shells. Cylindrical wampum beads were the most common variety (1221 specimens) and two outstanding forms of ornaments made of it were found. One of these consisted of a length of beaded band, outwardly like the historic "wampum belts" of the Iroquois, lying close to a skull near the base of the ossuary. The individual beads were arranged so that they lay at right angles to the length of the belt (Fig. 117, *d*). In the other example, a necklet or portion of such an ornament was found in front of the face of a skull near the center of the pit; it was composed of two strands of twenty-eight beads placed vertically in the necklet (Fig. 124, *f*). There were, besides these examples, numerous cases in which two or three beads adhered end-to-end, as well as others having a side-by-side arrangement (Fig. 124, *g*, *h*). Discoidal wampum stood next in order of abundance (228 specimens) and tubular beads next (45 specimens) (Fig. 123, *l*,

Fig. 119. An old cut illustrating an ossuary burial in progress.

p, *q*). The latter were notable for their symmetry. Large, heavy shell beads were principally of two types; the first of these rectangular in outline, and more or less uniform in thickness; while the others were also rectangular in outline but triangular in section (Fig. 123, *w*). Both were perforated longitudinally. Such beads have frequently been found on Huron sites, but seldom on sites of other known local cultures. The specimens from the ossuary were coated with a thick ocherous substance, not yet analyzed, which may either be a true paint or be due to circumstances of burial. Three crescentic beads of conch shell were evidently made in imitation of elk's teeth, with two and three perforations for suspension (Fig. 123, *o*). Finally, two large, more or less triangular pendants cut from the sides of conches completed the list of shell articles (Fig. 123, *v*). It is perhaps noteworthy that only ornaments were made of shell, at least for ossuary use; and that shells of exotic origin were so employed.

The one bone artifact was a small triangular pendant with two perforations near the larger end for suspension. It was carved just sufficiently to indicate the human form, but with a sureness of touch which suggests considerable ability (Fig. 124, *e*).

Articles made of stone ranked next in abundance to those of shell, and included several types. The most striking of these was a fine, vasiform pipe-bowl of green serpentine (Fig. 125, *b*), which was found on top of a lens of sand near the east end of the ossuary at a depth of about two feet below the surface. While many Huron vasiform pipes are round, this one has a rectangular rim and a body which never exceeds the rim's width. It is beautifully formed, with well-nigh perfect contours, and a highly polished perfectly plain surface. The only additional feature is the diminutive perforation, usually present in such pipes at the bottom for suspension. The bowl orifice is oval in outline while the cavity bears vertical scorings left by the sharp instrument with which it was hollowed out. The stem hole, conically bored, is placed on one of the narrow sides. Other stone artifacts were a "gaming piece," so-called; four projectile points, beads of catlinite, pigment and crystals of pyrite or marcasite. The first of these was made from a field pebble of discoidal shape which needed only a little alteration along one edge. The projectile points were all small, triangular and unnotched. They were found separately amongst the bones but not in positions which threw any light upon their associations (Fig. 124, *a-d*). Beads made from a red slate very much like catlinite were found in a variety of shapes such as tubular, square, triangular and discoidal (Fig. 123, *a-k*). Such slate beads appear to have become popular in late prehistoric or early historic times amongst the

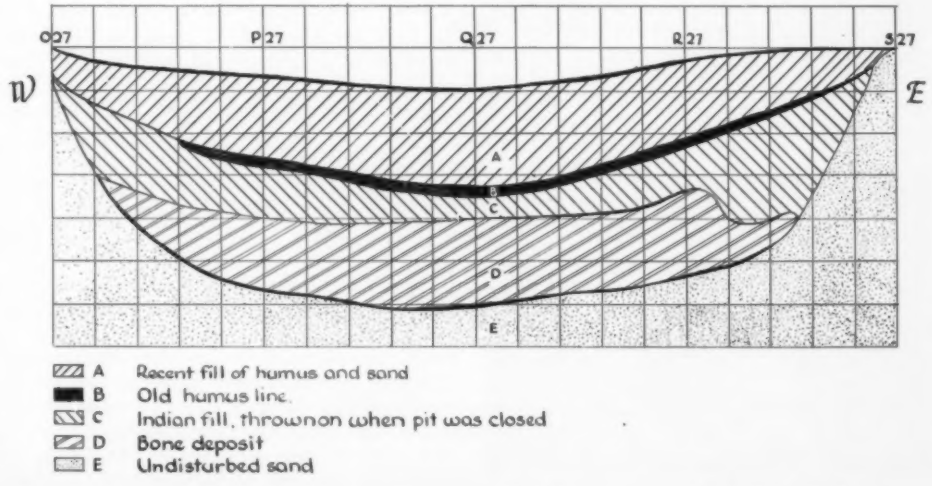

FIG. 120. Schematized cross-section through the ossuary. Each side of a square represents one foot.

Huron. Red ocher was found in three locations, usually in a powdery condition, the largest deposit containing forty-six grams. Two nodules of marcasite or pyrite in a sandstone matrix weighing respectively forty-four and one hundred and three grams had been placed with the dead. Finally, four chips of chert and one of granite were found in the ossuary.

The only pottery specimen found in the entire excavation was one clay pipe. It was well made of a light buff clay containing traces of mica, and was moderately well polished. The stem was conical and rather thick; it curved upward at somewhat more than a 90° angle to expand into a small globular bowl, tilted slightly toward the user. Its only decoration consisted of a series of small, vertical grooves running from base to rim of the bowl; the remainder was severely plain. Both the rim and the end of the stem had been ground flat. It is highly uncertain that this specimen should be included with the grave goods, for it was broken in two at the curve of the stem, and the two parts lay in widely separated locations along the north rim of the ossuary, but among the bones. It is possible that the pipe was in use when broken and discarded, rather than deposited for the use of the dead. Its presence, however, is significant since it is undoubtedly contemporary with the burial (Fig. 125, *a*).

Numerous specimens of textile material came to light, most of which were small fragments amounting to two or three square inches (Fig. 126, *b*). As already mentioned, most of such material appeared to have been wrapped around the bundles. Two weaves are discernible; the twined and a two-and-one twill; the former was much the more abundant.

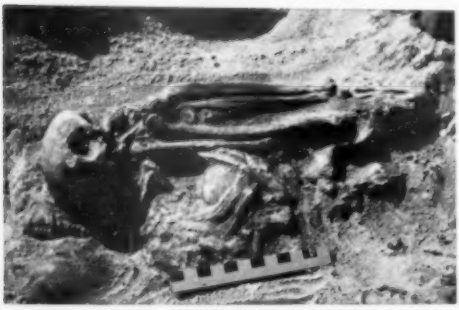

FIG. 121. Bundle burial No. 1. The scale is in inches.

FIG. 122. Conch shell. Maximum length — 11½ inches.

The twined weave is in all probability a native fabric, but there is some doubt about the twill since it was commonly used in Europe at the time and has not hitherto been reported from Ontario Indian sites. The fiber has been identified as hemp but the variety is uncertain.

Several pieces of braided rope were found in a rather limited area (Fig. 126, *a*). The material has not been identified.

Part of a large birch-bark basket lay in the bottom of a copper kettle, as described below, and had been made to fit it. The rim had been fitted with little wooden pegs to hold it together. While small pieces of birch bark were found frequently in other parts of the ossuary, this alone showed human workmanship.

Numerous examples of beaver skin came to light, preserved by the action of copper salts. The exterior of the largest kettle appeared to have been entirely covered with it, and probably also most of the interior. In other cases, scraps of it seemed to have been the remains of bundle wrappings. The most important piece, however, was about twenty-five centimeters square, and bore a rectilinear pattern in red paint. Unfortunately, this soon disappeared on drying. This fragment, moreover, had been sewn together from two smaller pieces in a very neat running stitch.

Small numbers of beech nuts occurred throughout the bone deposit. There is a possibility that some of these were present as a result of rodent activity, but undoubtedly most had been deposited with the dead at the time of interment. Remains of other organic materials were common, particularly the larvae and wings of the *Necrobia sp. Violacea*, or "bone beetles" but none had any cultural significance.

The proportion of European to native artifacts was rather large, but again the range was limited. Ornaments, of course, were numerous, consisting chiefly of glass beads of various sorts, bracelets and rings. Utility goods were represented chiefly by copper kettles and iron knives; such heavy types as axes were entirely absent. Novelties like the burning glass and the wineglass stem were rare.

Remains of two or three copper kettles came to light. None was even moderately well preserved and only one was in any sense complete. Two consisted of mere scraps sufficient to indicate diameters and one had part of the rim intact. The largest specimen was about two-thirds complete, including the bottom and parts of the sides (Fig. 127). It had been placed near the center of the pit on top of a few bones close to the floor. Since the rim, which is generally an iron hoop, was not to be found, it appears that the kettle was damaged when the burial occurred. Whether complete or not, the entire specimen had been wrapped in beaver skins, both inside and out, large areas of which were well preserved through contact with the copper. At the time of its discovery, the kettle contained the usual assortment of bones, and perhaps one bundle. On the bottom were the remains of the birch bark basket already described. The estimated diameter of the largest kettle is fifty-one centimeters. A smaller specimen, represented by part of the bottom, lay elsewhere on the floor of the pit, and was one of the last objects to be found in excavation.

There were an estimated twenty-five iron knives of a variety of types, such as table knives, butcher knives and jackknives. All but two were too badly corroded for details to be ascertained. The best preserved specimen was a butcher knife (Fig. 128, *c*) with three rivets to fasten the wooden handle-sheathing. Several of the table knives, which closely resembled some of their modern descendants, also retained portions of the wooden sheathing. The jackknife blade bore a mark now too worn

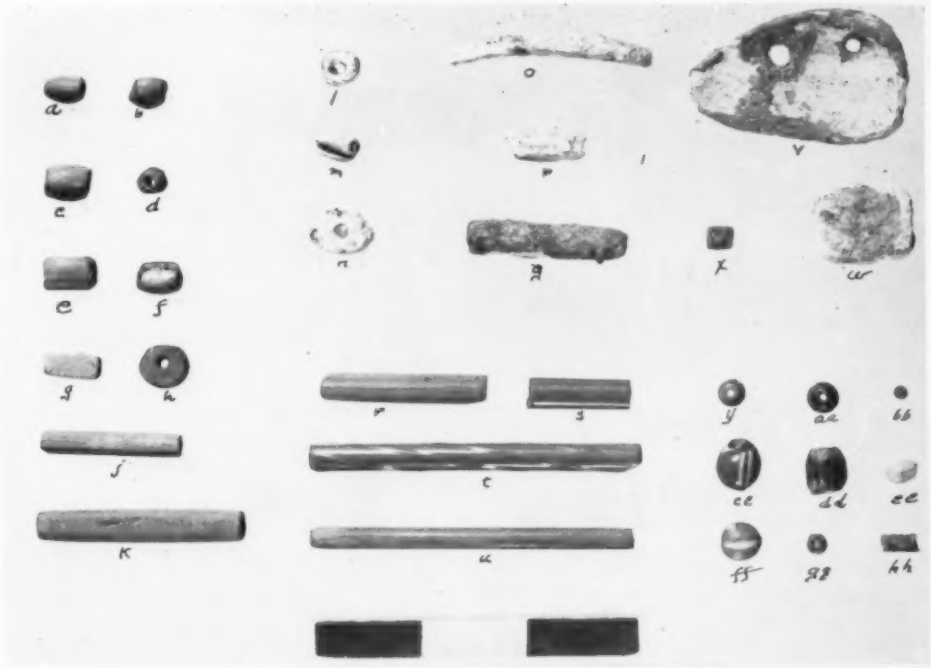

FIG. 123. Ornaments. *a-k*, slate beads; *l*, *n*, discoidal shell beads; *m*, *Olivella* shell; *o*, imitation elk tooth (?) of shell; *p*, *q*, tubular shell beads; *r-u*, long glass beads; *v*, shell pendant; *w*, heavy shell bead; *x*, wampum-style shell bead; *y-gg*, small glass beads; *hh*, copper bead. The scale is in inches.

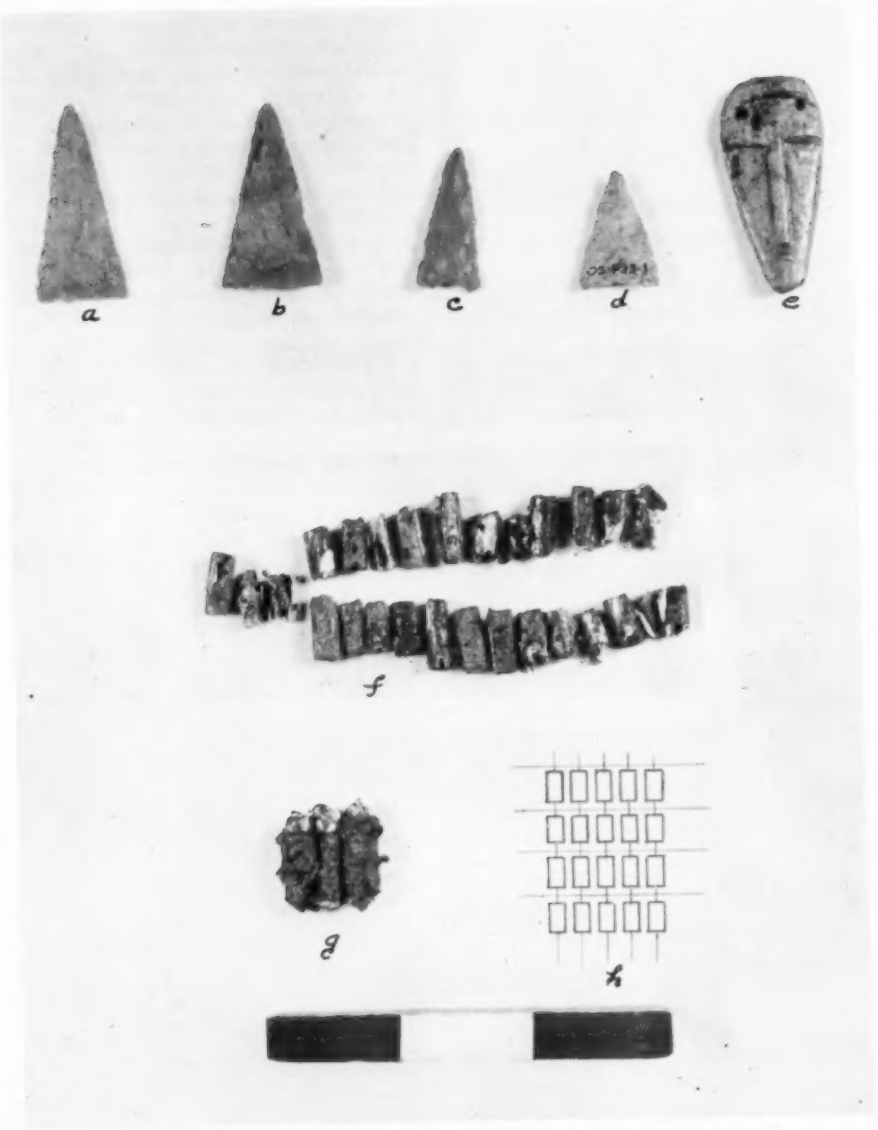

FIG. 124. Aboriginal artifacts of stone, bone and shell. *a-d*, stone projectile points; *e*, small bone carving; *f*, necklet of cylindrical shell beads, restored; *g*, cluster of shell beads; *h*, sketch to show method of stringing in *g*. The scale is in inches.

to be decipherable, but which was probably the maker's name. Other iron objects deposited in the pit were scissors, which differed in no essential way from our own; awls, a key and bracelets (Fig. 128, *b*, *a*, *d*, *e*). The awls were of the common sort, i.e. slender pieces of metal, square in section and tapering towards one end, with an offset crook at the center. The end of one specimen was still sheathed in its bone handle, merely a piece of the wing bone of a bird and obviously fitted by the Indians. Another specimen lacked a handle. The key could hardly have had any but prestige value. Bracelets were of various sizes, but all were simple affairs. Some were made from heavy bands of iron, others from sheet metal. The arm bones of one individual retained a set of six of the iron type. At least fifteen ornaments of this sort were found in the grave. Several lengths of iron bands used in the rims of kettles indicated the diameter of the original specimens. Except for an iron hook, the remaining iron objects were too corroded to yield any useful information, and most seem to have been merely scraps.

Apart from the beads described below, only two glass objects were found. The more important was a burning glass of low magnification and now much corroded (Fig. 128, *f*). The other was undoubtedly part of the stem of a wineglass, light greenish in color, and molded in two parts (Fig. 125, *g*). The body is almost square, with a corded rim and tapers to a pointed bottom, while the sides bear molded lion-masks on two sides. Extremely close

FIG. 125. Pipes and ornaments. *a*, clay pipe; *b*, pipe of serpentine; *c*, ring on finger bone; *d-f*, finger rings with bezels; *g*, part of wineglass stem. The scale is in inches.

FIG. 126. *a*, Length of braided rope; *b*, fragment of textile. The scale is in inches.

parallels were excavated in 1940 in London and are now in the Guildhall Museum. Their origin is thought to be either England or the Low Countries and to date from 1630-1660 (Oswald and Phillips, 1949, Figs. IV left, and IX right).

Red, blue, white and polychrome glass beads lay in most parts of the ossuary, in some cases in groups which would suggest that they had been strung together (Fig. 123, *r-u*; *y-gg*). All but the polychrome existed in a variety of shapes, such as round, tubular, and twisted beads, some of them in solid colors, others with cores of a color different from the exterior, and a few with stripes of contrasting hue. The polychrome were chiefly of the well-known "candy" type. Out of a total of 467 specimens, the largest single class consisted of red beads of round and ring shapes. One of the most interesting groups was that which imitated the red slate beads of the Huron; the glass was a dull red which could only be distinguished from the slate on a fractured surface, and the forms into which it had been blown included the tubular, square and triangular beads of the native styles (Fig. 123, *s*, *u*).

There were six copper finger rings, two of them on finger bones, and all but one of which had been imported; the exception was a rude, open band. The others all had bezels and well-fashioned circles; the simplest had a self-bezel whose surface bore a star bordered by two vertical impressed lines (Fig. 125, *d-f*). Two of the bezels still retained their glass faces and behind one of them a reddish substance was visible. Other copper objects included the kettle already referred to; eighteen cylindrical beads from four to six centimeters long (Fig. 123, *hh*), and probably made from European kettles, and one round copper bangle of sheet metal about two and one-half centimeters in diameter.

History of the Ossuary

The existence of ossuaries in the territory occupied by the Huron has been known since the beginning of Canadian history. The first writer to mention them was Champlain (Biggar 1929, vol. 3, pp. 160-163); Sagard (1939, pp. 203-204) describes them at greater length, while Jean de Brebeuf left the fullest and most satisfactory first-hand account of them and of the ceremonies connected with them (Thwaites, 1897, vol. X, pp. 279-305). Later authors, like Juvencius (1710, p. 54), used the primary sources to prepare for their readers second-hand accounts of the remarkable custom. While information on the practice of this type of interment lay buried in European libraries, the ossuaries themselves were hidden in the virgin forest which grew up over them after the abandonment of their old habitat by the Huron in 1651. Upon the influx of settlers to the region in the early years of the 19th century, the forests were cleared and the ossuaries were easily identified. Being so conspicuous on the face of the land, they were inevitably opened, first through curiosity on the settlers' part, but later because they were found usually to contain highly desirable copper kettles and other European metal goods. By the end of the century, few had escaped detection and pillaging.

The finding of the ossuary whose excavation is the subject of this paper must be credited entirely to Frank Ridley, a keen student of

Fig. 127. Copper kettle *in situ*.

FIG. 128. Artifacts of European Origin. *a*, iron awl set in bone handle; *b*, remains of a pair of scissors; *c*, iron knife mounted in wooden handle; *d*, iron key; *e*, iron bracelet; *f*, burning glass. The scale is in inches.

Ontario archaeology. Ridley, thoroughly familiar with the exploration accounts pertaining to the country of the Huron, set for himself the task of trying to identify some of their towns in the vicinity of Nottawasaga Bay (Ridley, 1947, pp. 7-14). After tracing out to his satisfaction a stretch of nearly eight miles of the great Huron trail leading from Cedar Point, opposite Christian Island, due south to the Petun country, he decided to attempt the identification of some of the Huron towns mentioned in the *Jesuit Relations* as having been situated upon the great trail. One of these towns, called *Ossossane* in the 18th century French orthography, was situated on a high headland protected on three sides by escarpments and on the fourth by a wooden fortification built by the French in a rhomboidal form. The situation of the town, together with the fortifications, suggested to the French the appearance of the town of La Rochelle in the homeland, and it was by this name that they officially designated it. The country to the south was described as marshy, and uninhabitable, leaving Ossossane the Huron town closest to the Petun country. Making proper allowances for changes which have occurred in the three hundred years elapsed since the French occupation, Ridley had no difficulty in establishing the site of the village of Ossossane as being on the promontory in the south half of lot 17, concession 6, Tiny township.

As identified by Ridley, Ossossane occupies a level plain bounded on the west by a very deep and abrupt escarpment and on the south by a somewhat less rugged one which leads down to a small stream. The western escarpment drops to a ravine formed by a ridge of sand-dunes which run along the base of the headland for many miles and in which are evidences of the great trail; one and one-half miles to the west, over a low and swampy terrain, lies Nottawasaga Bay. Southward the land becomes less suitable to or impossible of habitation, because much of it is occupied by Cranberry Lake and beaver meadows. Both

Indian and European goods lie in abundance on the supposed site of the village, but whether the remains of the French fortifications are there could only be revealed by systematic excavation.

The important point in connection with Ossossane, for the purpose of this paper, is that the Jesuit priest, Jean de Brebeuf records in the *Relation for 1636* that a great "Feast of the Dead," at which he was present, was held there in that year. The story is best told in Brebeuf's own words, omitting certain short passages which are irrelevant to our present interest. The account presented below is taken from the Thwaites edition of the *Jesuit Relations*, Volume X, pages 279-305. (The modern counterpart of this ceremony is recently described by Fenton and Kurath [1951, pp. 139-165].)

The feast of the Dead is the most renowned ceremony among the Hurons; they give it the name of feast because, as I shall now fully relate, when the bodies are taken from their Cemeteries, each Captain makes a feast for the souls in his Village, — the most considerable and most magnificent having been that of the Master of the Feast, who is for that reason called par excellence, the Master of the feast.

This Feast abounds in ceremonies, but you might say that the principal ceremony is that of the kettle; this latter overshadows all the rest, and the feast of the Dead is hardly mentioned, even in the most important Councils, except under the name of "the kettle." They appropriate to it all the terms of cookery, so that, in speaking of hastening or of putting off the feast of the Dead, they will speak of scattering or of stirring up the fire beneath the kettle; and, employing this way of speaking, one who should say "the kettle is overturned," would mean that there would be no feast of the Dead.

Now usually there is only a single feast in each Nation; all the bodies are put into a common pit. I say, usually, for this year, which has happened to be the feast of the Dead, the kettle has been divided; and five Villages of the part where we are have acted by themselves, and have put their dead into a private pit. He who was Captain of the preceding feast, and who is regarded as the Chief of this place, has given as an excuse that his kettle and his feast had been spoiled, and that he was obliged to make another; . . .

Twelve years or thereabout having elapsed, the Old Men and Notables of the Country assemble, to deliberate in a definite way on the time at which the feast shall be held to the satisfaction of the whole Country and of the foreign Nations that may be invited to it. The decision having been made, as all the bodies are to be transported to the Village where is the common grave, each family sees to its dead, but with a care and

Fig. 129. The Place Royale in the middle of the seventeenth century. (From an engraving by Pérelle, in Hénard — Les jardins et les squares, pl. 13.)

FIG. 130. Aerial view of the site of Ossossane village, from the south. Courtesy of Mr. F. W. Taylor.

affection that cannot be described: if they have dead relatives in any part of the Country, they spare no trouble to go for them; they take them from the Cemeteries, bear them on their shoulders, and cover them with the finest robes they have. In each Village, they choose a fair day, and proceed to the Cemetery, where those called *Aiheonde*, who take care of the graves, draw the bodies from the tombs in the presence of the relatives, who renew their tears and feel afresh the grief they had on the day of the funeral. I was present at the spectacle, and willingly invited to it all our servants; for I do not think one could see in the world a more vivid picture or more perfect representation of what man is. . . . For, after having opened the graves, they display before you all these Corpses, on the spot, and they leave them thus exposed long enough for the spectators to learn at their leisure, and once for all, what they will be some day. The flesh of some is quite gone, and there is only parchment on their bones; in other cases, the bodies look as if they had been dried and smoked, and show scarcely any signs of putrefaction; and in still other cases they are still swarming with worms. When the friends have gazed upon the bodies to their satisfaction, they cover them with handsome Beaver robes quite new: finally, after some time they strip them of their flesh, taking off skin and flesh which they throw into the fire along with the robes and mats in which the bodies were wrapped. As regards the bodies of those recently dead, they leave these in the state in which they are, and content themselves by simply covering them with new robes. Of the latter they handled only one Old Man, of whom I have spoken before, who died this Autumn on his return from fishing: this swollen corpse had only begun to decay during the last month, on the occasion of the first heat of Spring; the worms were swarming all over it, and the corruption that oozed out of it gave forth an almost intolerable stench; and yet they had the courage to take away the robe in which it was enveloped, cleaned it as well as they could, taking the matter off by handfuls, and put the body into a fresh mat and robe, and all this without showing any horror at the corruption. . . .

The bones having been well cleaned, they put them partly into bags, partly into fur robes, loaded them on their shoulders, and covered these packages with another beautiful hanging robe. As for the whole bodies, they put them on a species of litter, and carried them with all the others, each into his Cabin, where each family made a feast to its dead.

. . . . .

A day or two before setting out for the feast, they carried all these souls into one of the largest Cabins of the Village, where one portion was hung to the poles of the Cabin, and the other portion spread out through it; the Captain entertained them, and made them a magnificent feast in the name of a deceased Captain, whose name he bore. I was at this feast of souls, and noticed at it four peculiar things. First, the presents which the relatives made for the feast, and which consisted of robes, Porcelain collars, and kettles, were strung on poles along the Cabin, on both sides. Secondly, the Captain sang the song of the deceased Captain, in accordance with the desire the latter had expressed, before his death, to have it sung on this occasion. Thirdly, all the guests had the liberty of sharing with one another whatever good things they had, and even of taking these home with them, contrary to the usual custom of feasts. Fourthly, at the end of the feast, by way of compliment to him who had entertained them, they imitated the cry of souls, and went out of the Cabin crying *haé, haé*.

The master of the feast, and even *Anenkhiondic*, chief Captain of the whole Country, sent several pressing invitations to us. You might have said that the feast would not have been a success without us. I sent two of our Fathers, several days beforehand, to see the preparations and to learn with certainty the day of the feast. *Anenkhiondic* gave them a very hearty welcome, and on their departure conducted them himself a quarter of a league thence, where the pit was, and showed them, with great demonstrations of regard, all the preparations for the feast.

The feast was to take place on the Saturday of Pentecost;[1] but some affairs that intervened, and the uncertainty of the weather, caused it to be postponed until Monday. The seven or eight days before the feast were spent in assembling the souls, as well as the Strangers who had been invited; meanwhile from morning until night the living were continually making presents to the

[1] Father Hourigan of the Jesuit Seminary, Toronto, kindly calculated the date of Pentecost in 1636, and arrived at the date of May 11.

youth, in consideration of the dead. On one side the women were shooting with the bow for a prize, — a Porcupine girdle, or a collar or string of Porcelain beads; elsewhere in the Village, the young men were shooting at a stick to see who could hit it. The prize for this victory was an axe, some knives, or even a Beaver robe. From day to day the souls arrived. It is very interesting to see these processions, sometimes of two or three hundred persons; each one brings his souls, that is, his bones, done up in parcels on his back, under a handsome robe, in the way I have described. Some had arranged their parcels in the form of a man, ornamented with Porcelain collars, and elegant bands of long red fur. On setting out from the Village, the whole band cried out *haée, haé*, and repeated this cry of the souls by the way. This cry they say relieves them greatly; otherwise the burden, although of souls, would weigh very heavily on their backs, and cause them a backache all the rest of their lives. They go short journeys; our Village was three days in going four leagues to reach *Ossossané*, which we call la Rochelle, where the ceremonies were to take place. As soon as they arrive near a Village they cry again *haée, haé*. The whole Village comes to meet them; plenty of gifts are given on such an occasion. Each has his rendezvous in one of the Cabins, all know where they are to lodge their souls, so it is done without confusion. At the same time, the Captains hold a Council, to discuss how long the band shall sojourn in the Village.

All the souls of eight or nine Villages had reached la Rochelle by the Saturday of Pentecost; but the fear of bad weather compelled them, as I have said, to postpone the ceremony until Monday. We were lodged a quarter of a league away, at the old Village, in a Cabin where there were fully a hundred souls hung to and fixed upon the poles, some of which smelled a little stronger than musk.

On Monday, about noon, they came to inform us that we should hold ourselves in readiness, for they were going to begin the ceremony; they took down at the same time, the packages of souls; and the relatives again unfolded them to say their last adieus; the tears flowed afresh. I admired the tenderness of one woman toward her father and children; she is the daughter of a Chief who died at an advanced age, and was once very influential in the Country; she combed his hair and handled his bones, one after the other, with as much affection as if she would have desired to restore life to him; she put beside him his *Atsatonewai*, that is, his package of Council sticks, which are all the books and papers of the Country. As for her little children, she put on their arms bracelets of Porcelain and glass beads, and bathed their bones with her tears; they could scarcely tear her away from these, but they insisted, and it was necessary to depart immediately. The one who bore the body of this old Captain walked at the head; the men followed, and then the women, walking in this order until they reached the pit.

Let me describe the arrangement of this place. It was about the size of the place Royale at Paris (see Fig. 129).[2] There was in the middle of it a great pit, about ten feet deep and five brasses wide. All around it was a scaffold, a sort of staging very well made, nine to ten brasses in width, and from nine to ten feet high; above this staging there were a number of poles laid across, and well arranged, with cross-poles to which these packages of souls were hung and bound. The whole bodies, as they were to be put in the bottom of the pit, had been the preceding day placed under the scaffold, stretched upon bark or mats fastened to stakes about the height of a man, on the borders of the pit.

The whole Company arrived with their corpses about an hour after Midday, and divided themselves into different cantons, according to their families and Villages, and laid on the ground their parcels of souls, almost as they do earthen pots at the Village Fairs. They unfolded also their parcels of robes, and all the presents they had brought, and hung them upon poles, which were from 5 to 600 toises in extent; so there were as many as twelve hundred presents which remained thus on exhibition two full hours, to give Strangers time to see the wealth and magnificence of the Country. I did not find the Company so numerous as I had expected; if there were two thousand persons, that was about all. About three o'clock, each one put away his various articles, and folded up his robes.

Meanwhile, each Captain by command gave the signal; and all, at once, loaded with their packages of souls, running as if to the assault of a town, ascended the Stage by means of ladders hung all round it, and hung them to the cross poles, each Village having its own department. That done, all the ladders were taken away; but a few Chiefs remained there and spent the rest of the afternoon, until seven o'clock, in announcing the presents which were made in the name of the dead to certain specified persons.

"This," said they, "is what such and such a dead man gives to such and such a relative." About five or six o'clock, they lined the bottom and sides of the pit with fine large new robes, each of ten Beaver skins, in such a way that they extended more than a foot out of it. As they were preparing the robes which were to be employed for this purpose, some went down to the bot-

[2] Brebeuf refers here to the public square in the Quartier des Marais, Paris, now known as *Place des Vosges*. It is located near the eastern end of Ile St.-Louis, on the north bank, less than a mile from the Place de la Bastille. Henri IV rebuilt the square (1605-15) and made it the show place of Paris; hence it was a landmark well known to readers of the *Jesuit Relations*. The Jesuit church, Eglise St.-Paul-St.-Louis, was nearby. Wyatt quotes Sir Reginald Blomfield (Blomfield, A history of French Architecture) to the effect that the square had an area of 5184 toises (Wyatt, p. 10); allowing six feet to a toise, the English equivalent is approximately 4.3 acres, and the length along a side about 430 feet. The Place, however, is not exactly square.

Descriptions may be seen in Baedeker (1912, p. 200), Clunn (1933, p. 95), Henard (1911, pp. 57-62), Muirhead and Monmarche (1924, pp. 41-43), Ritchie (1951, p. 65), Rochegude et Dumolin (1923, pp. 99-100), Tilley (1922, p. 543), Wolff (1921, pp. 119-122) and Wyatt (1928). Maps and plans may be consulted in Baedeker, Ritchie, and Tilley; illustrations in Henard and Wolff above.

tom and brought up handfuls of sand. I asked what this ceremony meant, and learned that they have a belief that this sand renders them successful at play. Of those twelve hundred presents that had been displayed, forty-eight robes served to line the bottom and sides of the pit; and each entire body, besides the robe in which it had been enveloped, had another one, and sometimes even two more, to cover it. That was all; so that I do not think each body had its own robe, one with another, which is surely the least it can have in its burial; for what winding sheets and shrouds are in France, Beaver robes are here. But what becomes then of the remainder? I will explain, in a moment.

At seven o'clock, they let down the whole bodies into the pit. We had the greatest difficulty in getting near; nothing has ever better pictured for me the confusion there is among the damned. On all sides you could have seen them letting down half-decayed bodies; and on all sides was heard a horrible din of confused voices of persons, who spoke and did not listen; ten or twelve were in the pit and were arranging the bodies all around it, one after another. They put in the very middle of the pit three large kettles, which could only be of use for souls; one had a hole through it, another had no handle, and the third was of scarcely more value. I saw very few Porcelain collars; it is true, they put many on the bodies. This is all that was done on this day.

All the people passed the night on the spot; they lighted many fires, and slung their kettles. We withdrew for the night to the old Village, with the resolve to return the next morning, at daybreak, when they were to throw the bones into the pit; but we could hardly arrive in time, although we made great haste, on account of an accident that happened. One of the souls, which was not securely tied, or was perhaps too heavy for the cord that fastened it, fell of itself into the pit; the noise awakened the Company, who immediately ran and mounted in a crowd upon the scaffold, and emptied indiscriminately each package into the pit, keeping, however, the robes in which they were enveloped. We had only set out from the Village at that time, but the noise was so great that it seemed almost as if we were there. As we drew near, we saw nothing less than a picture of Hell. The large space was quite full of fires and flames, and the air resounded in all directions with the confused voices of these Barbarians; the noise ceased, however, for some time, and they began to sing, — but in voices so sorrowful and lugubrious that it represented to us the horrible sadness and the abyss of despair into which these unhappy souls are forever plunged.

Nearly all the souls were thrown in when we arrived, for it was done almost in the turning of a hand; each one had made haste, thinking there would not be room enough for all the souls; we saw, however, enough of it to judge the rest. There were five or six in the pit, arranging the bones with poles. The pit was full, within about two feet; they turned back over the bones the robes which bordered the edge of the pit, and covered the remaining space with mats and bark. Then they heaped the pit with sand, poles, and wooden stakes, which they threw in without order. Some women brought to it some dishes of corn; and that day, and the following days, several Cabins of the Village provided nets quite full of it, which were thrown upon the pit.

We have fifteen or twenty Christians interred with these Infidels; we said for their souls a *De profundis*, with a strong hope that, if divine goodness does not stop the course of its blessings upon these Peoples, this feast will cease, or will only be for Christians, and will take place with ceremonies as sacred as the ones we saw are foolish and useless; they are even now beginning to be a burden to them, on account of the excesses and superfluous expenses connected with them.

The whole morning was passed in giving presents; and the greater part of the robes in which the souls had been wrapped were cut into pieces, and thrown from the height of the Stage into the midst of the crowd, for any one who could get them; it was very amusing when two or three got hold of a Beaver skin, since, as none of them would give way, it had to be cut into so many pieces, and thus they found themselves almost empty-handed, for the fragment was scarcely worth the picking up. In this connection, I admired the ingenuity of one Savage, — he did not put himself to any trouble to run after these flying pieces, but, as there had been nothing so valuable in this Country, this year, as Tobacco, he kept some pieces of it in his hands which he immediately offered to those who were disputing over a skin, and thus settled the matter to his own advantage.

. . . . . .

As to the rest of the twelve hundred presents, forty-eight robes were used in adorning the pit. Each whole body had its robe, and some had two or three. Twenty were given to the master of the feast, to thank the Nations which had taken part therein. The dead distributed a number of them, by the hands of the Captains, to their living friends; some served only for show, and were taken away by those who had exhibited them. The Old Men and the notables of the Country, who had the administration and management of the feast, took possession secretly of a considerable quantity; and the rest was cut in pieces, as I have said, and ostentatiously thrown into the midst of the crowd. However, it is only the rich who lose nothing, or very little, in this feast. The middle classes and the poor bring and leave there whatever they have most valuable, and suffer much, in order not to appear less liberal than the others in this celebration. Every one makes it a point of honor.

The account ends by explaining how it came about that Estienne Brusle and Guillaume Chaudron were not buried in this pit, as the Indians at first desired.

Brebeuf's visit to and subsequent description of this particular ossuary burial rings down the curtain upon it for two centuries. We have, it is true, the two accounts of the custom left us by Champlain and by Sagard, which are useful to us because they describe Huron

ossuary burials in general, and particularly because they point out many similarities to that seen by Brebeuf, and in at least one detail mention one important difference. (They both relate that "beds" or layers of axes, kettles, "collars," and other goods were put in the bottoms of ossuaries, yet such an arrangement was emphatically absent from Brebeuf's example.)

History throws little additional light upon the site again until the 1870's. About that time, the land was cleared and farming began in the district. Andrew F. Hunter, who will always be remembered with gratitude by students of archaeology for his remarkable survey of Huron sites, left a brief observation upon this ossuary in his "Notes on Sites of Huron Villages in the Township of Tiny" (pp. 35-36) and in his notebooks; he says it was first mentioned in 1869, and that "a few bones had been found in it. . . ." Hunter himself saw four empty cache pits close by and two or three which were almost obliterated, while "in the ground immediately around the pit," he says, "there were camp fires, near one end of which he (the owner) had once found a steel sword, much rusted." The cache pits, empty or otherwise, could not be found in 1949, nor could the campfires, but the primary grave may have been one of the pits to which Hunter refers. Hunter's account is to some extent supplemented by three first-hand descriptions which the writer was able to obtain from old residents of the district. The first of these was Napoleon Daoust, uncle of the present owner, and a man who, in 1949, had lived nearby for 85 or 86 years. His father's farm was only two lots to the west of the site. When Napoleon Daoust first remembered the place, it was still in forest, and while most of the surrounding land was somewhat wet, the spot on which the ossuary stood was dry. When he was seven years old, he saw the ossuary "dug out to a depth of four feet," skulls thrown out and "many" brass kettles removed. He was entirely unable to recall the number, unfortunately, but he affirmed that they were deep cylindrical in shape and had been placed on top of the bones. His brother Julien, seven years younger than Napoleon, and suffering from partial paralysis when interviewed, said he also remembered when the ossuary was opened, but since this would be impossible, he may have meant that he remembered *hearing* that it was opened. At any rate, he asserted that beads and kettles were taken out of it. Finally, Mr. F. S. Stott, of Wyevale, aged 76 in 1948, said that he came to the district at the age of ten; that his father operated a sawmill on the corner of the Daoust farm, and that in his earliest recollection the ossuary field had already been deforested. He was as emphatic as the Daousts in his assertion that the pit had been opened, for in his youth he saw skulls lying about "in much better conditions than those found now," and he knew of at least one kettle which had been taken out. Apart from these three informants, there were no others who recalled the early modern history of this ossuary; and, as we have seen, no one had disturbed it in recent years except the present owner. It is apparently accurate to say therefore that the ossuary was first noticed in modern times in the 1860's, and partly explored during that decade, but that since that time, it had been left undisturbed.

The extent and significance of the 1860-1870 examination are not entirely clear. The final excavation showed that disturbance was slight, reaching the bottom only in a small area on the north side. Evidence of digging was noticed in the overburden but judging by the number of bones which had been mixed with its sand, it had not been very extensive. There is, of course, the eye-witness evidence of the elder Daoust to the early disturbance, and Stott's statement to the same effect. That the pit was explored at the early date there can be no doubt, but just as certainly the exploration was of limited extent.

With these facts in mind, let us return for a moment to a consideration of the identity of the site. In the final analysis, complete identification of the ossuary must hinge upon that of the village of Ossossane. As things stand at present, the evidence for this is excellent, but final proof will only be forthcoming upon excavation to see whether the French fortifications exist there. If they do, then either the ossuary described here or that on the Parnell farm was the one visited by Brebeuf in 1636. The latter is situated on lot 16, concession 6 of the township of Tiny, on the south side of the ravine from the site of the village. Hunter (1899, p. 36) records that it was opened between 1881 and 1887, and he inclined to the belief that since it contained finger rings it was probably the Brebeuf pit. The one here

discussed also contained finger rings, cancelling out this part of the evidence. The Parnell site seems to be situated too close to the village to be Brebeuf's ossuary and since it is situated on the opposite side of the ravine, its location would be somewhat inconvenient. Unfortunately, no exploration of this site is likely since the pit has been filled in, ploughed over, and the location lost.

The Brebeuf account refers to the sandy nature of the ossuary site (Thwaites, 1897, Volume X, pp. 289-291). If an area of one-quarter of a league is marked out, with the village site as its center, the land it encompasses will be found to include no sandy areas except the Daoust and Parnell fields, thus narrowing down the possibilities to these two, for no other ossuaries are known to exist within it. The distance from the excavated ossuary to the village agrees with that mentioned by Brebeuf, while that from the Parnell farm to the village is too short.

Many of the details described by Brebeuf and seen in the excavation would doubtless apply to most if not all Huron ossuaries, and hence can be disregarded in the search for identifying evidence. This is true, it would seem, of the lining of the pit with beaver skin (295-297), the sandy nature of the soil in which it was dug (297), the general confusion of the bones, the robes and wrappings of bundles (297), the refuse of sand, poles and wooden stakes heaped upon it after the burial (297-301), and the multitude of fires which burned in the field (297). Similarly, there is nothing very conclusive about such observations as that one woman put "bracelets of Porcelain and glass beads" on the arms of her deceased children (293); that whole bodies were put in the bottom of the pit (293-295; 297) where they were arranged by ten or twelve men; nor even that five or six other men pushed down the bones with poles as they were thrown in to keep them from piling up in the center, or that the pit was filled to within two feet of the top (299). They merely contribute to the probability that this was Brebeuf's ossuary, since they are in no way contradictory to the excavation's findings, but are in agreement with them, as far as is possible in the nature of the case.

Much more significant are the statements that the pit was situated one-quarter of a league from the village (289-291); that it was ten feet deep and five brasses wide, with a scaffolding around it ten brasses in diameter (293); that three large brass kettles which could only be of use for souls were placed in the very middle of it (297), and finally, that the French had fifteen or twenty Christians interred in the place (301). The first statement has already been discussed at length, and found to agree with the situation of this ossuary. As for the dimensions of the pit, as given by Brebeuf, they correspond amazingly closely with those actually recorded during excavation. The depth as reported was too great, but one must remember that when the estimate was made, there was a bank of sand surrounding the pit which would make it appear deeper than it actually was. The diameter was more accurate, if one allows five feet to one brass which is the ratio given by Cotgrave in his contemporary dictionary (Cotgrave, 1611); it was, in fact, almost exactly correct for the orifice of the pit. Brebeuf's estimate of the diameter of the scaffold also corresponds with the dimensions as revealed by excavation. All these measurements seem too close to the specific dimensions of this particular example to be a matter of coincidence. Concerning the finger rings, it has already been remarked that their evidence is largely cancelled by the presence of similar ones in the Parnell ossuary. However, it is perhaps worth noting that the number in the Daoust pit would correspond to the probable number of married women included in the fifteen or twenty Christian burials referred to in the Brebeuf account, assuming that all had been used as wedding bands.

Only the three large kettles remain as the final and crucial evidence. If they were found, the case would be clear almost beyond dispute. But the account states finally that they were in such a condition as to be of use only for souls when they were buried; i.e. they were in very poor condition indeed. Time and decay would then take their toll, not to mention vandalism. Excavation, however, brought to light the larger part of one kettle, and probably portions of one or more others. The fragments were too small and too corroded to be pieced together, so that it cannot be known exactly how many kettles were represented. The issue is still further complicated by the disturbance of the ossuary in the 1860's and by the report of the removal of kettles at that time.

Summary

If the evidence for the identity of this ossuary is not one hundred per cent conclusive, it is nevertheless convincing. Minor details revealed in the excavation agree, for the most part, with the description given by Brebeuf as do also its general location and relationship to village ruins nearby. The three kettles would have offered the most conclusive proof, but since Brebeuf states that they were in an extremely bad condition when deposited, it is not to be wondered at that their remains were fragmentary and unsatisfactory when found. No serious disturbance had occurred in this ossuary, and reports that kettles had been removed from it should be considered in the light of local traditions and of the fact that the witnesses were very old men whose memories may not have been clear. There seems to be almost no doubt that this is the ossuary visited by Brebeuf during the Feast of Pentecost, 1636, and the one in which the Huron of Ossossane village deposited the remains of their kindred at that time.

Since this is the first ossuary in the Georgian Bay region to have been completely excavated by modern methods, it occupies a unique place in the archaeology of the Northeast. Data upon its location, size and contents throw new light upon one of the most highly elaborated culture traits of this branch of the Iroquois peoples. Its excavation yielded a large amount of skeletal material which will ultimately be of great value in assessing the physical, dental and pathological conditions of this tribe, and their mortality rate. If our identification and dating are correct, the material was deposited prior to the great smallpox epidemic of 1639 and to the adoption of the Wenro about the same time. In other words, the remains can be taken confidently to be those of the western branch of the Huron, known as the Bear clan, and of persons who died between *ca.* 1624-1636. Thus, the people and the date are known with unusual accuracy. Cultural remains from the ossuary, likewise accurately datable, throw an equally illuminating light upon the material condition of the Huron at this time, and upon the processes of acculturation as they were working themselves out amongst them.

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RECENT DATA FROM TWO PALEO-INDIAN SITES ON MEDICINE CREEK, NEBRASKA

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EXCAVATIONS IN DEEPLY BURIED paleo-Indian sites of late Wisconsin age in the Medicine Creek Reservoir area, Nebraska, have resulted in the appearance of a number of preliminary statements in recent years. The present statement, anticipating publication of a complete report of the work, has been prepared in order to make available certain data not hitherto reported.[1]

This report is concerned with data from two stratified sites, the Lime Creek site (Ft-41)[2] and the Red Smoke site (Ft-42), in both of which artifact assemblages including Plainview points have been found. These two sites are on Lime Creek, a small western tributary of Medicine Creek. They are near the Allen site (Ft-50) on Medicine Creek, source of the Frontier complex (Holder and Wike, 1949). As yet no specific relationship has been found to exist between the Frontier complex and the material from Lime Creek and Red Smoke, and therefore the Allen site will not be discussed in this paper. Geologically the situations of all three sites are very similar.

Medicine Creek is a major northern tributary of the Republican River in the dissected loess plains of southwestern Nebraska, just west of the 100th meridian. In this area the streams flow in steep-walled valleys a hundred and more feet deep. Remains of alluvial terraces along the valley walls testify to a complex fluvial history for the region. Here and there a terrace remnant has been eroded by floods, and a vertical cliff exposing the loessic terrace-fill has resulted. Each of the two early sites is deeply buried within the fill of a terrace remnant and has been brought to light by such flood action.

This topographic situation has made it possible to relate the archaeological investigations to geological and paleontological work which has been carried on as part of the same research program by Schultz and his associates. The geological investigations have resulted in the delineation of a local sequence of stream terraces, terrace-fills, buried soils, and fossil assemblages. This sequence has been correlated with a general sequence worked out for Nebraska as a whole. That sequence, in turn, has been correlated with the widespread climatic fluctuations which have taken place during glacial and postglacial times. Schultz and his colleagues assign both archaeological sites to the lower part of the Terrace-2A fill, associated with the complex of buried soils called Soil YY. In terms of the general Pleistocene chronology, the formation of Soil YY, and the occupation of the sites by early hunters, is believed to have taken place in the Two Creeks or Cary-Mankato interstadial of the Wisconsin glacial age and in the early part of the Mankato or Wisconsin-4 glacial sub-age. (Schultz *et al.*, 1948, 1951.)

Most of the bones found associated with cultural material in these sites are of bison, but a variety of small and large game is also represented. According to Schultz, some of the faunal elements represented are similar to modern forms, whereas others seem to be

[1] The publication now in preparation will report the results of a coordinated program of geological, paleontological, and archaeological research in the Medicine Creek Reservoir area carried on by the University of Nebraska State Museum as part of the scientific salvage program in reservoir areas of the Missouri Basin (Davis and Schultz, 1952). The archaeological work has been supported in part by funds from the following: the National Park Service, Hector Maiben, Mr. and Mrs. Ben Maiben, and Childs Frick funds, all through the University of Nebraska Foundation; the University of Nebraska Research Council; and the U.S. Bureau of Reclamation. The cooperation of the Laboratory of Anthropology of the University of Nebraska and the Missouri Basin Project of the Smithsonian Institution also is gratefully acknowledged.

Special thanks are due the present landowner of the Red Smoke site, Robert J. Williams, and the earlier owners, Mr. and Mrs. Jess Stansbie and Albert L. Brown, for their generosity and hospitality. It is also a pleasure to acknowledge the support and cooperation given by Bernard Corder, Bureau of Reclamation caretaker at the Medicine Creek Dam, and Mrs. Corder.

James H. Gunnerson, graduate student at Harvard University, was field supervisor at the Red Smoke site in 1952. The geological work cited here was done by C. B. Schultz, G. C. Lueninghoener, W. D. Frankforter, and L. G. Tanner.

[2] The site designations Ft-41, Ft-42, and Ft-50 are those used by the University of Nebraska State Museum. According to the system used by the Smithsonian Institution and several other organizations, these sites would be listed as 25FT41, 25FT42, and 25FT50, respectively.

extinct species. The bison bones resemble the extinct *Bison antiquus* rather than the modern *B. bison*.

THE LIME CREEK SITE

The Lime Creek site contains three occupational strata called, beginning with the lowest, zones I, II, and III, in the lower part of a fifty-foot loess cliff. The site was first discovered in 1947, and the work done that year, which has been summarized in a report by Schultz and Frankforter (1948), was entirely in zone I. The work was continued by the present writer in all three zones in 1949, and was concluded in 1950 when the filling of the reservoir caused the inundation of the site. The cultural zones are so deeply buried that much of the site could not be investigated because of the problem of overburden removal.

The sedimentary sequence within this terrace-fill consists of a bluish clay at the base, a 25-foot series of immature soil zones above, and a thick deposit of loess at the top. Zone I is in and on the top of the basal bluish clay. Zone II is three feet above zone I and is associated with an immature soil zone. Zone III, also associated with an immature soil, is eight to nine feet above zone I.[3] A radiocarbon date of 9524 ± 450 years has been determined for charcoal collected by the writer one to two feet below the top of the basal bluish clay (Arnold and Libby, 1951, p. 116, sample no. 471). It seems advisable to regard this figure only as an indication of the general time interval involved rather than as a date to be placed in a sequence, because the charcoal was not collected under optimum conditions and it was possible to obtain only a single sample.

[3] Zones I, II, and III correspond respectively to sedimentary units 12, 10, and 8 in the description of this section by Schultz, *et al.* (1951, pp. 30-31). In terms of a less detailed description published earlier by the same authors (1948, p. 37), all three cultural zones are within sedimentary unit 5.

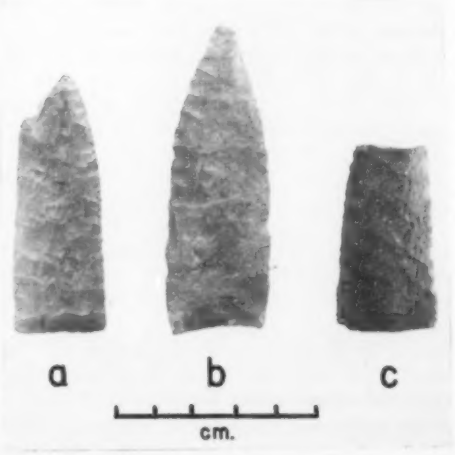

FIG. 131. Points from the Lime Creek site, zone III.

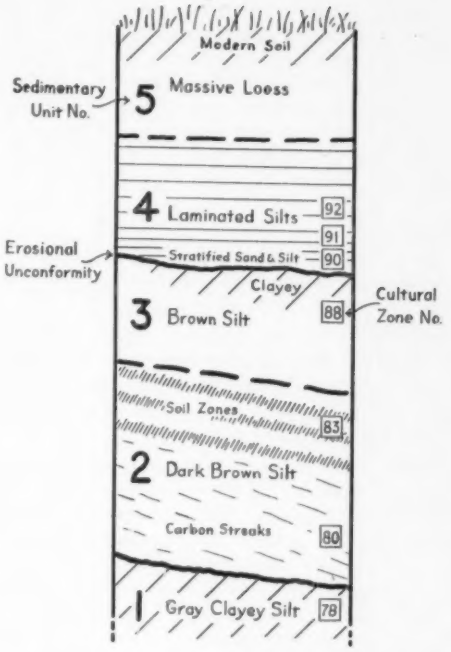

FIG. 132. Red Smoke site (25FT-42). Idealized stratigraphic section. Not to scale. Height approximately 25 feet. Units vary in thickness.

Zone I. Much of the material from zone I has been described by Schultz and Frankforter (1948, pp. 48-54, Figs. 2-10) and subsequent work by the present author has not changed the picture which they presented. The data will be summarized very briefly in order that certain comparisons may be made. The zone is primarily a workshop, with great amounts of flint chips. The artifact inventory includes a variety of scrapers, knives, and chopping tools. The most characteristic artifact is a well-made blade with straight base and

roughly parallel sides. Two points of the general Scottsbluff category came from this zone.

The present writer concurs in the opinion of Forbis and Sperry that there is a striking resemblance between one of the two Scottsbluff points from zone I and certain specimens from the Scottsbluff level at the MacHaffie site near Helena, Montana (Forbis and Sperry, 1952, p. 130 and Fig. 62, 2-4). It is further significant that these authors note a close resemblance between the Lime Creek zone I blades and rectangular knives, which they do not illustrate, from the Scottsbluff level at MacHaffie.

Zone II. Finds in this zone were limited to bone fragments, a few flint chips, three scrapers, and a chopping tool. None of these artifacts are distinctive.

Zone III. In this zone were found two hearths around which were quantities of burned and broken bison bones and much flint-chipping debris. The artifact inventory includes a very few scrapers, crude blades, and knives, and the tip fragments of two points. Three distinctive specimens were found associated with one hearth. They were two Plainview points and the midsection of a point with parallel oblique flaking.[4]

One of the Plainview points, No. 7604 (Fig. 131, *a*), is intermediate in dimensions between TMM 725-10 and TMM 725-23 from the Plainview site. It differs from these two specimens in having irregular flaking and no median ridge on either face, a straight rather than concave base, and no basal or edge grinding.

The other Plainview point, No. 7605 (Fig. 131, *b*), is almost identical in appearance to TMM 725-8. It differs in being slightly larger in all dimensions, in having a shallower basal concavity, in lacking edge and basal grinding, and in having fine retouch on the right edge of each face.

The obliquely flaked specimen, No. 7607 (Fig. 131, *c*), has straight, slightly converging edges and regular parallel oblique flaking on both faces. As the specimen is oriented in Figure 131c, the upper half of the right edge of each face is unifacially beveled, the beveling having been done before the oblique flakes were removed. The edges are finely retouched but not ground.

[4] The term *Plainview* is used in this report to designate points which are very close to or within the range of variation in shape and workmanship of the specimens from the Plainview site in Texas. In the comparisons which follow, specimen numbers beginning "TMM 725-" refer to points from the Plainview site, now in the Texas Memorial Museum, as described and illustrated by Krieger (1947, Table 4 and Plates 3-5) and Sellards (1952, Figs. 30-32).

The presence of the two Plainview points indicates that zone III has cultural affiliations with the Plainview site and with Red Smoke zone 88, which is discussed later in this paper. The alternate beveling on the obliquely flaked specimen and the alternate edge retouch on the larger Plainview may be a reflection of the same tradition which is manifested in the alternate beveling on a number of specimens from Red Smoke zone 88.

Although the evidence in zones I and II suggests a change in projectile point tradition, a functional analysis of the assemblages in the two zones indicates that throughout the history of the Lime Creek site the patterns of economic activity underwent little change. The site was used primarily as a workshop where artifacts were made from jasper obtained at nearby outcrops. At the same time bison and other animals were being hunted and eaten and their skins were being processed. The fact that the cultural strata are thin suggests that people remained at this site only briefly.

The Red Smoke Site

The Red Smoke site is a low cliff exposure on the north side of Lime Creek valley about one-third mile west of the Lime Creek site. Much of the Terrace-2 surface here has been deeply eroded so that the cultural strata are more accessible than at the Lime Creek site. The site was discovered in 1947 and some preliminary testing was done that year (Schultz and Frankforter, 1948, Fig. 1). The writer has worked at the site in the seasons of 1949 through 1952. The summary presented here is based primarily on the work done through the season of 1951, since the data obtained in 1952 have not yet been analyzed. Certain significant data obtained in the 1952 work are, however, noted here.

A generalized stratigraphic section in the central portion of the site is shown in Figure 132. The seven cultural zones are numbered according to the height above site datum at which each was first found. Sedimentary unit I in this section is believed to correlate with the basal bluish clays at the Lime Creek site, and units 2, 3, and probably 4 with the immature soil zones above the bluish clay. The erosional unconformity between units 3 and 4 is an important sedimentary feature at Red Smoke which has not been noted at the Lime Creek site. This unconformity represents a

lapse of time of undetermined duration. It is hoped that radiocarbon dates can be obtained for the deposits immediately above and below the unconformity, but as yet no radiocarbon dates have been determined for the site.

Zones 92, 91, and 90. Cultural manifestations in these three higher zones are scattered and discontinuous, and the information recovered from them is limited. All three zones contained hearths, red and yellow ocher stains, bone fragments, flint chips, and a few artifacts including chopping tools and scrapers. Sandstone grinders were found in zones 92 and 90. Zone 91 contained the base of a stemmed point (Fig. 134, *a*). A small pentagonal flake point was found in zone 90. It is probable, although not demonstrated, that the material from these three zones makes up a single complex representing occupation by hunting peoples who stopped here occasionally to avail themselves of the jasper in the nearby outcrops. Whether these artifacts are related to the assemblages from lower zones is unknown because the artifact sample from the three higher zones is so small. Grinding tools and ocher are very rare, and stemmed points absent, below zone 90. This difference is probably significant in the light of the time lapse indicated by the erosional unconformity below zone 90.

Zone 88. This zone is the richest occupational stratum at Red Smoke. Here and there within the zone, which is about one foot thick, discontinuous lenses of silt occur, representing the accumulation of slope wash between times of occupation. Cultural evidences include great amounts of flint chips and fragmentary bison bones, and a number of hearth areas. More than five hundred identifiable artifacts had been found in this zone by the end of the 1951 season and this number was considerably augmented in 1952. Flint-working was evidently the primary activity here, as at the Lime Creek site, with bison hunting and skin processing next in importance. Blades and choppers, scrapers, and points are numerically the most important functional categories of artifacts.

Almost half of the artifacts from zone 88 are bifacial chopping and cutting tools, but the only distinctive shape is represented by a small number of well-made thin blades with convex edges and straight bases (Fig. 134, *g*).

Scrapers range in form from slightly retouched flakes to a few carefully made end scrapers, roughly triangular in outline (Fig. 134, *e*, *f*).

Plainview points are the principal diagnostic artifacts from zone 88. At the present writing 26 partial or complete specimens have been found (Fig. 133, *a-f*, *i-l*). On most specimens the tip is missing and the base is present, in contrast to the situation at Plainview where tips are usually present and basal fragments are rare. This difference must reflect the fact that the Plainview site is a kill, where tips are broken off or whole points are lost, whereas Red Smoke is a workshop and campsite, where the shaft is brought back and what is left of the point is removed from the shaft and replaced.

No. 8244 (Fig. 133, *a*) is like TMM 725-10 from the Plainview site in size, outline, and flaking. It differs in broadening slightly from the base forward, like TMM 725-13, and in not being basally ground. The tip was presumably short.

No. 8245 (Fig. 133, *b*), a slightly "fishtailed" specimen, is like TMM 725-5 in outline, but is larger. The flaking is regular and horizontal like that on TMM 725-23. It

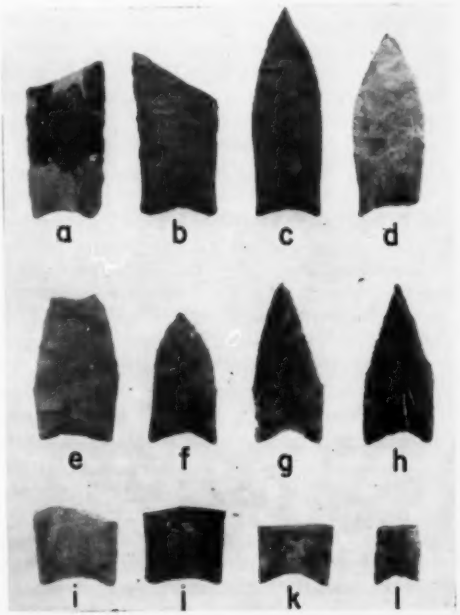

FIG. 133. Points from the Red Smoke site, zone 88. Half size.

is ground on the base and lower edges. The tip was presumably short.

Nos. 8787 and 8786 (Fig. 133, *c, d*) are like TMM 725-5 in having a slight constriction above the base, but they are a little smaller and less angular in outline, and both specimens have the right tip edge of each face unifacially beveled. The constriction above the base is due in part to edge grinding. No. 8787 was not found in primary position, although all other specimens in Figure 133 were. This specimen was found in redeposited silts below zone 88, but almost certainly derived from that zone.

Other variants of Plainview points from zone 88 are shown in Figure 133, *e, f, i-l*. Most of them are made from local materials. One interesting exception is *i*, which is made of "Alibates flint" from the Texas panhandle.

Two points from zone 88 are apparently Plainview points reworked at tip and base to serve as scrapers or drills (Fig. 133, *g, h*). An additional specimen resembling these two was found in slump material below zone 88. These points represent a specialized functional variant of the Plainview point for which the writer suggests the name "Meserve point." These points are shorter and stubbier than Plainviews, the tip is more than half the total length of the specimen, and the tapering tip edges make an angle with the parallel basal edges. The tip edges are unifacially beveled for their full length, the bevel being on the right edge of the face when the tip is upward. This alternate unifacial beveling produces a rhomboidal cross section near the tip. Fine, irregular, unifacial flaking is visible on the beveled tip edges, suggesting that these "points" were used for scraping or boring.

There is some evidence, which can not be reviewed in this brief statement, that this variant form may have a different history from that of the Plainview form proper, and it seems useful to give the variant a noncommittal name of its own to serve until the true archaeological significance of the form is better known. Similar specimens were found at the Meserve bison quarry near Grand Island, Nebraska, in 1931 and at the Gibson site near Abilene, Texas, in 1940 (Schultz, 1932, p. 274, Fig. 166 c; Ray, 1940, p. 231, Plate 42, no. 15). The term "Gibson point" has been employed by Ray, but since this usage might imply association with the unrelated Gibson aspect of the Caddoan area, it is felt here that "Meserve point," after the earlier discovery, is a preferable term.

There are significant resemblances between the artifact assemblages from Red Smoke zone 88, Lime Creek zone III, and the Plainview site. Geological evidence indicates that all three sites are of about the same age. The artifacts from the recently reported Brohm site on the north shore of Lake Superior are also much like the material from Red Smoke zone 88 (MacNeish, 1952; compare his Plate III, 1 with Fig. 133, *c*, and Plate VI, 2, with Fig. 134, *f*). The early to middle Lake Algonquin date given the Brohm site may be later than the early Mankato age attributed to Red Smoke zone 88.

Zones 83, 80, and 78. These deeply buried zones have not yet been extensively investigated. Hearth areas and some bone scraps have been found, and scanty evidences of flint chipping occur along with a few scrapers and heavy chopping and cutting tools. A point resembling a Plainview, but narrower and thicker, has been found in zone 83 (Fig. 134, *b*). In zone 80 two basal fragments have been found which appear to be the bases of Plainview points (Fig. 134, *c*). This scanty evidence suggests

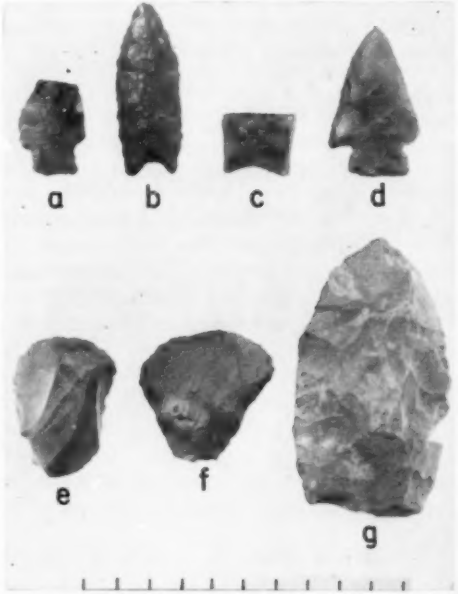

FIG. 134. Artifacts from the Red Smoke site. *a*, zone 91; *b*, zone 83; *c*, zone 80; *d*, zone uncertain; *e, f, g*, zone 88. Scale is cm.

that lanceolate, concave-based points were used for an appreciable length of time at this site.

Finds of uncertain stratigraphic position. Two stemmed points (Fig. 134, *d*) were found in a deep trench dug back into the terrace in 1952. A confusing sedimentary situation makes it impossible to determine the stratigraphic relationship of these specimens to the known cultural zones, although they are from the same part of the terrace-fill.

Prospects. The Red Smoke site is at the edge of the reservoir and is partially flooded when unusually heavy rains raise the water level. It may be destroyed should there be a major flood. The site is extensive and much of it remains to be investigated, but unfortunately the overburden problem increases with each season's work. It is planned that excavations will continue at Red Smoke until such time as the returns no longer justify the effort.

OBSERVATIONS

The stratigraphic and taxonomic data from the Lime Creek and Red Smoke sites lead to certain inferences regarding the activities of the people who lived there. In the typological sequence suggested by the evidence, points of the general Scottsbluff category are succeeded by Plainview points which are present through a considerable time span, and stemmed points appear some time later. The sample is very small, however, except for the Plainview points in Red Smoke zone 88, and much more data are needed before this sequence can be considered other than tentative.

Information on patterns of life during the successive occupations of the two sites derives mainly from Red Smoke zone 88 and Lime Creek zone I. In both of these zones the primary activity was the manufacture of artifacts from jasper quarried at nearby outcrops. Bison and a few other animal species were also being hunted, butchered, cooked, and eaten, and there was some dressing of skins. The scattered finds in other zones suggest that the same economic activities were being carried on throughout the successive occupations of these sites. It is not possible to say how large the groups were that camped here, but the indications are that their visits were brief.

A significant aspect of these finds lies in the fact that at these two sites archaeological assemblages have been found in a specific geological context. In this case the context points to an interstadial period, the Two Creeks interval, within the late Wisconsin glacial age. During the time of man's occupation of the Great Plains there have been several major climatic fluctuations which have caused significant changes in stream activity and in plant and animal life, and it is through the accumulation of integrated archaeological, geological, paleontological, and paleobotanical data that the role of man in this fluctuating ecological situation can eventually be outlined. The information from the Medicine Creek paleo-Indian sites will contribute to the fulfillment of this objective.

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University of Nebraska State Museum
Lincoln, Nebraska
November, 1952

RALPH DUNCAN BROWN

RALPH DUNCAN BROWN (Chief of the Missouri Basin Project, River Basin Surveys, Smithsonian Institution) died in Lincoln, Nebraska, on September 7, 1952, as the result of accidental injuries. He was born in Minneapolis, Minnesota, on March 7, 1907. After receiving his B.A. from the University of Minnesota, in 1929, Brown was a member of an expedition of the Department of Anthropology of the university, doing archaeological work in Algeria and in the Dordogne, France. The following year he was a fellow of the Laboratory of Anthropology, Santa Fe, one of a group assisting in the excavation of sites in the Whitewater District, Eastern Arizona. For several years thereafter, Brown continued archaeological work in Minnesota, particularly at the Harvey rockshelter, near Marine-on-St. Croix, which he reported briefly in the *Proceedings* of the Minnesota Academy of Science. He was also active at this time in the Minnesota Archaeological Society, in whose quarterly he published several notes. He spent the summer of 1935 as a member of a field party at the Kincaid mounds, then being excavated by the Department of Anthropology of the University of Chicago.

In 1936 Brown became assistant supervisor of the Minnesota Historical Records Survey, a WPA project sponsored by the Minnesota Historical Society, subsequently becoming its supervisor. A part of the work of this project was archaeological, and excavations were conducted under his direction at the site of the North West Company fur-post at Grand Portage, and at the site of Fort Ridgely, a frontier military post. At the first site Brown was personally in charge of field work. In 1938 Brown joined the WPA Archaeological Survey of Kentucky sponsored by the University of Kentucky, subsequently becoming its state supervisor.

Entering military service as a selectee in 1942, and receiving training at Fort Leonard Wood and Fort Belvoir, Brown was commissioned in 1943 in the U. S. Corps of Engineers, being assigned to the Army Map Service. Here he remained until the following year, when he was sent to combat duty. Passing through the New Guinea, Leyte, and Luzon campaigns, Brown then served in GHQ, SCAP, Tokyo. He was discharged from service with the rank of Major, in 1947, but remained for an additional period as a civilian employee of the War Department. During the last two years of his duty in Japan, and employing Japanese students at his own expense, Brown conducted two archaeological investigations. One of the sites excavated, the Ubayama shell mound, near Tokyo, has been dated by means of C-14 analysis of charcoal from structural remains from a house area in the bottom levels of the mound. Returning to the States in 1949, Brown carried on various historical and archaeological studies, and in February of 1952 joined the Missouri Basin Project.

Brown had numerous interests aside from archaeology, notably local history, particularly of Canada and the British Isles. His interest in photography was specially keen, and he spent much time, after his return from military service, at a summer cabin that he built and furnished, in Canadian waters on Rainy Lake. His zest for life and his enthusiasm were felt by all who knew him, a wide circle of friends and acquaintances who mourn his untimely death.

—G. HUBERT SMITH

FACTS AND COMMENTS

THE CLAY FIGURINES OF ACAMBARO, GUANAJUATO, MEXICO

For the past eight years, stories have appeared concerning a vast collection of animal and human figurines of great antiquity, gathered in the vicinity of Acambaro in the state of Guanajuato, Mexico. Senor Waldemar Julsrud possesses some 32,000 of these artifacts in his private collection. These ceramic figures consist of such forms as Brontosaurus, Tyrannosaurus Rex, Stegosaurus, Trachodon, Dimetrodon and other Mesozoic reptilian life-forms. Also included in the collection are a number of modern life-forms such as cow, horse, hippopotamus, elephant, rabbit, and dog. Even more fabulous is the number of miniature Egyptian sarcophagi found in the collection.

Such popular articles as have appeared in the Los Angeles Times (Mexico Finds Give Hint of Lost World, by Lowell Harmer, Los Angeles Times, March 25, 1951, pt. 2, pp. 1-2), Fortnight (Archaeological Quandary by William N. Russell, Fortnight Nov. 12, 1951, pp. 38-39) and Fate Magazine (Did Man Tame the Dinosaur? by William N. Russell, Fate Magazine Feb.-March, 1952, pp. 20-27.) all emphasize the thought that man possessing the knowledge of ceramics lived contemporaneously with the Mesozoic reptiles. This, if true, would have thrown either the archaeological prehistory time-scale out of line or would have seriously shifted the paleontologists' concept of sequence dating. Senor Julsrud in his paper *"Enigmas Del Pasado,"* (Acambaro, Gto., 1947), indicated that the archaeologists were mistaken in their estimates of time.

The Amerind Foundation, Inc., was prevailed upon to make an investigation of the materials. To imply falsification merely on the strength of the life-forms represented was not sufficient, for there was always the bare possibility that the figurines were chance similarities to Mesozoic forms as defined by modern scientists in the last two hundred years. It was within the realm of chance that they were the work of some imaginative prehistoric artist who may have taken his inspiration from the smaller reptiles still in existence today. A number of sherds were sent to the Amerind Museum and were tested in the laboratory. Chemical tests were made of the soils composing the figurines. Sherds were crushed and the contents were inspected for any inclusions that might give a clue as to the date of manufacture. Laboratory tests proved nothing. It was therefore decided that a representative should be sent into the field to witness the actual excavation of these figurines.

The author arrived in Acambaro in June and examined the collection owned by Senor Julsrud. The examination raised grave doubts as to the antiquity of the materials. Both the great variability of form and the volume of material were disturbing. Further, none of the specimens were marred by patination nor did they possess the surface coating of soluble salts characteristic of objects of more certain antiquity coming from the same area. Upon the word of the owner none of the figures had been washed in acid. Examination showed the edges of the depressions forming eyes, mouths, or scales to be sharp and new. No dirt was packed into any of the crevices.

The figures were broken, in most cases, where the appendages attached themselves to the body of the figurines; it appeared that the manufacturers willfully broke legs, necks, tails, etc., to suggest age. No parts were missing. Further, none of the broken surfaces were worn smooth. In the entire collection of 32,000 specimens no shovel, mattock, or pick marks were noted. This would indicate that the excavators possessed a digging technique exceeding anything known to professional archaeologists or that they knew precisely where to dig. Their field technique when witnessed on the site, however, indicated that they were neither skillful nor careful nor experienced.

The excavators, consisting of a father and his son, invited the author to their site, an actual prehistoric Tarascan ruin. To make the test-find, they chose the northwest corner of a room approximately nine meters long and four meters wide. The author spent two days watching the excavators burrow and dig; during the course of their search they managed to break a number of authentic prehistoric objects. On the second day the two struck the cache and the author examined the material *in situ*. The cache had been very recently buried by digging a down sloping tunnel into the black fill dirt of the prehistoric room. This fill ran to a depth of approximately 1.30 m. Within this stratum were authentic Tarascan sherds, obsidian blades, tripod metates, manos, etc., but these objects held no concern for the excavators. In burying the cache of figurines the natives had unwittingly cut some 15 cms. below the black fill into the sterile red earth floor of the prehistoric room. In back-filling the tunnel they mixed this sterile red earth with the black earth; the tracing of their original excavation was, as a result, a simple task.

In their attempt to disguise the figurines they had packed the bowls and crevices with dirt, the same mixed dirt as characterized the backfill of their new-cut tunnel. Not only was the dirt thus mixed but small chips of limestone, chipped from the boulder walls of the prehistoric room during excavation of the tunnel, were also in evidence.

As if to cap the case, finger prints were visible on the freshly packed earth which filled a small bowl. This bit of evidence, plus the presence of some fresh animal manure in the tunnel fill, offered proof enough that the material had been recently planted.

Further investigation revealed that a family living in the vicinity of Acambaro make these figurines during the winter months when their fields lie idle. Their ideas of form could have come from the local cinema in Acambaro as well as from the multitude of comic books and newspapers sold on the streets. Or from the library as well as the school, which are available in the town, which has a population of some 20,000 persons. Three

trains a day carry natives to Mexico City where the Museo Nacional, among others, is available and where, incidentally, there is a fine collection of prehistoric Egyptian art. Certain forms in the Julsrud collection strongly suggest that some of the native manufacturers have visited this Egyptian exhibit.

Apparently these objects have been made and sold since 1944, when the first cache was opened for Senor Julsrud's inspection. Intrigued by the wierd forms he began his collecting and paid a peso for each item brought to his home. Since the above mentioned date the material has all come from three small fields in mass concentrations, and Sr. Julsrud has continued to buy.

Thus the investigation ended; it seems almost superfluous to state that Acambaro figurines are not prehistoric nor were they made by a prehistoric race who lived in association with Mesozoic reptiles.

CHARLES C. DI PESO
Amerind Foundation,
Dragoon, Arizona.
August, 1952

COPPER SPECIMENS FROM YADKIN RIVER IN PIEDMONT, NORTH CAROLINA

In the upper Piedmont region of North Carolina, along the Yadkin River, specimens of copper have been found at three village sites.

As illustrated, the largest specimen appears to be a copper breast plate. Five tubular beads are represented. Seven pieces are roughly cone-shaped and could be classified as decorative bangles, although those which are more proportional and smoothly finished could have been used as arrow tips. The two triangular pierced pendants were found at sites forty miles apart. The copper hawk's bell, a trader's piece evidently of English origin, still rings merrily when shaken. A broken half of the same design was found forty miles away at another site. Two fragments of unfinished copper are illustrated (Fig. 135).

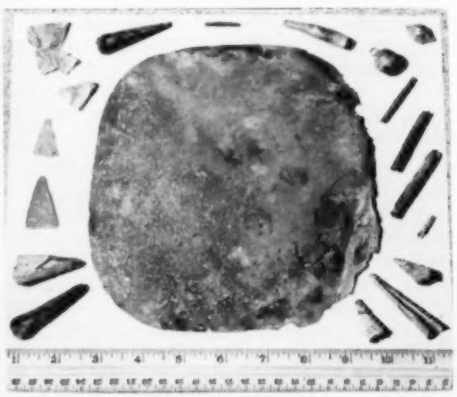

FIG. 135.

There is no deposit of copper in this region of the Yadkin River. There is a possibility that some outcrops of copper were available in the mountains of North Carolina or in the Tennessee region beyond, but the material illustrated probably came from much farther away.

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Wachovia Historical Society
Winston-Salem, N.C.
October, 1952

FIRST NOTE ON THE ARCHAEOLOGY OF THE MOHAWK TOWN OF OSSERNENON

The grounds of the shrine dedicated to three of the canonized North American Martyrs, in the township of Auriesville, N.Y., have long been believed to embrace the site of the Mohawk town of Ossernenon. The two reasons for such an opinion have been principally: the topography, and the surface finds. To this evidence may be added the sundry post-contact Indian graves found nearby. In order to locate and study the town accurately, excavations were made on the shrine grounds, during the summer of 1952, under the direction of the writer.

The site is situated on a terrace, some 400 feet above sea level, on the south side of the Mohawk River, 40 miles up the river from its confluence with the Hudson, and a mile upstream from the juncture of the Schoharie River with the Mohawk. The area is represented on the Fonda Quadrangle of the U.S. Geological Survey maps, and on the map accompanying the monograph of Brigham (1929, p. 60), who calls this terrace the Schoharie Wash Plain, and identifies it to be a lacustrine formation dating from the closing phase of the last glaciation.

Attention was first drawn to the site by the investigations of General John S. Clark, in 1877. His reasoning, based on his excellent knowledge of the terrain and on careful reading of the *Jesuit Relations*, impressed such of his contemporaries as the historian, John Gilmary Shea,* and it impresses the modern scholar no less. The chief source in the *Relations* is the account given by St. Isaac Jogues (Thwaites, 1896, Vols. 25, 31, 39), after his first visit to, and captivity in, Ossernenon.

Ossernenon was the town of the Turtle clan, the foremost of the three Mohawk clans. The time of its occupancy was the first part of the period of Mohawk Ascendency — 1634-1666 (Carse, 1949, p. 7). Before the expeditions of de Courcelles and De Tracy against the tribe (in 1666), all three towns were south of the Mohawk River, between the mouth of the Schoharie and the present town of Canajoharie. Ossernenon was moved to Gandawague, about a mile west of our site, in 1659; after the De Tracy expedition, the new Turtle clan town was Caughnawaga, on the north of the river, in the present town of Fonda (Grassmann, 1952, p. 33).

* Copies of Clark to Shea letters are on file at the Auriesville Shrine.

The town of Caughnawaga has been very largely excavated by the V. Rev. Thomas Grassmann, O.F.M.Conv., and his work has been of primary importance in assisting us to understand the problems and evidence of our site; his personal and kindly help to us has also been great.

The topographic and pedological conditions obtaining at Caughnawaga and in Auriesville are essentially the same; both are similar terraces. Both sites were early farmed by the white successors to the Indians, and were picked over by collectors for surface finds. However, because a public shrine was opened at Auriesville in 1885 and maintained continuously ever since, with thousands of pilgrims each summer, our surface finds have completely vanished from the site. Some are preserved in museums and collections. The various changes, made for the improvement of the shrine, have added to the problems which challenge the archaeologist.

However that may be, the conditions under which the evidence is unearthed are as follows: The top soil, a dark sandy loam, varies in depth, but averages about 25 centimeters. It is, for the most part, in this topsoil that the artifacts are found. Because of ploughing and erosion of the soil, colonial and later artifacts are likely to be compressed with the Indian ones. Colonial ash pits intrude into the next lower level, as do isolated artifacts. This next layer is a yellow sand, which contrasts clearly with the discolorations left by the now long-rotted palisade and other posts thrust into the ground by the Mohawks.

FIG. 136. A posthole mold partially bisected, the rest being followed to show its outer form. The indication of another post is at the top of the illustration. (Scale 15 cms.)

Discolorations resulting from other causes are rather easily recognized.

The illustration (Fig. 136) shows such a discoloration, which has been cleared of yellow sand, so as to show the pointed form of the original post (point of lower arrow). Near the upper end, one may note the round dark spot which indicates another post (upper arrow). This latter is what one sees, as the ground is carefully cleared down to the yellow sand. Such a round spot, of course, could have been caused by a root; there is no absolutely sure way of determining its nature, except by bisecting it longitudinally and clearing away one half. The pointed form verifies the nature of the evidence.

During this past season, work was suspended after we had found a large number of such posthole molds, but had not found the palisade of the town. We made various soundings in search of the palisades, and came to the conclusion that we had discovered the evidence of houses outside the palisade. At this period in Mohawk history, it would seem, much of the town was outside the palisade, which formed a place of retreat and defense analogous to the medieval castle in Europe (Carse, 1949, p. 7).

As the town dump has not yet been found, and no storage pits have been located, the artifacts were discovered in the topsoil, only a random few having sunk down into the sand. Dating the site by exclusive association is, therefore, still not feasible. However, the fact that this was a Mohawk village of a time when the Indians were in contact with the whites is eminently clear from the former surface finds, the nearby graves, and from our finds of the summer.

These last included objects which were clearly Mohawk, objects capable of having been used by both Mohawks and Dutch, and objects which were predominantly colonial. In the first class we may list: firestone beads and pendants; shell wampum beads; a perforated phalanx of a young deer; a discoidal muller; a conical metal arrow point; flint projectile points. In the second class were: many fragments of metal pots; metal trade knives; many fragments of clay pipes; gun flints; a musket ball. In the third class we have: handmade nails; fragments of early glass; a leaden ladle; Colonial pottery; several ash pits in which fragments of brick occurred. The remains of food animals, with the exception of those of *Bos, Equus* and *Sus*, belong in the second class: *Ursus; Castor; Cervus; Canis*; a number of as yet unidentified bird and small mammal bones; *Unio* shells. Bones of the turtle were regarded with interest, since this was a Turtle clan town, but no conclusion could be drawn concerning their importance.

In addition to locating part of the town, our trenches and the numerous postholes we dug helped delimit the field of endeavor for the season of 1953, during which we hope to uncover the whole village. Obviously, the size and arrangement of the village, the palisades and the gates, will add materially to our knowledge of Mohawk life of this period.

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October, 1952

UNUSUAL LAMAR VARIANT OF THE FILFOT CROSS

Figure 137 shows an unusual form of the so-called filfot cross, a favorite design motif on early and late Mississippi stamped pottery of the southern United States. Although several forms of the "filfot" design have been illustrated by Holmes, Heye, Hodge, and Pepper, Caldwell and McCann, and others, I have never seen this particular variant before, nor one to equal it in ingenuity. It is a minor masterpiece of native American complicated design.

I have reconstructed the motif from two badly overstamped potsherds from a cache of two Lamar vessels exposed when a cedar stump was dug from the southwest slope of a watermelon patch (in 1939) on the Castelberry farm overlooking bottomlands of the left or northeast bank of Chestatee River, Hall County, northern Georgia. Although I could find no surface evidence of a village site in the vicinity, the cache itself has been given the designation 2-HL.

I suppose W. H. Holmes (1903, p. 134) first gave the name "filfot cross" to this group of designs, on the basis of their central element, a "cross" of bent or curved arms, thus resembling to a certain extent the fylfot, swastika, or gammadion of the Old World. In the five or six different American variants that I have seen, the four elements or groups of lines do not actually cross each at their central intersection; instead, they abut, giving the impression of passing over and under each other, this central portion resembling the "lined blocks" design of early Mississippi Etowah Stamped (Wauchope, 1950, Fig. 8), which is derived from an earlier Woodland motif (Woodstock Stamped in northern Georgia). The late Mississippi (Lamar, Irene, Overhill, etc.) version of this central area may be elaborated to contain a raised square or circle (as in Caldwell and McCann, 1941, Fig. 20, or Holmes, 1903, Pl. CXIV, b). In this new specimen from Hall County, however, the three basic inner lines of each element actually cross those of the other groups, thus creating four depressed squares at the very center of the entire design.

The Hall County variant is unique in other ways, too. Only three of the lines in each of the four elements reach directly in a straight line from one element to the opposite element. The other three, by an ingenious combination of different processes, continue into the adjacent element. The outermost line (we may call it No. 6) doubles back on itself and simply frames the entire design; in the specimens illustrated by Holmes there are sometimes four or more such framing lands. No. 5 terminates in a "dead end" at one side of two of the design elements, but becomes No. 4 in the other two elements, where it can be recognized by its square-based U shape. Note that only line No. 4 crosses lines 1-5.

The reader will obtain a healthy respect for the Indian artist if he will make this experiment: Memorize the general scheme of the pattern from Figure 137, then try to reproduce it from memory, keeping your drawing in respectable proportions and to scale. It will be found that even when the complicated pattern has been conceived, working it out in proportions that fit and leave room for *all four* elements is not easy. Note that the Indian artist's solution of the corner treatment of line No. 4 (a broad U in two elements, a deep L in the other two) must be followed if the four elements are to be pulled tightly together without leaving much open area in the center of the design.

Since this variant of the filfot cross is unique so far as I can ascertain (Heye, Hodge, and Pepper's Pl. XXXV, lower left sherd, may possibly be similar), I should like to request archaeologists to be on the lookout for it, in order to determine whether it has geographical or chronological significance, or whether it was merely a whim of one Hall County virtuoso. Small portions of the design can easily be mistaken for the more usual forms of filfot cross or even figure-of-eight; I made this error myself (Wauchope, 1950, Fig. 10 b, is one of the 2-HL potsherds). Archaeologists searching for this pottery in other watermelon patches, however, should remember that they are doing so purely in the interest of science.

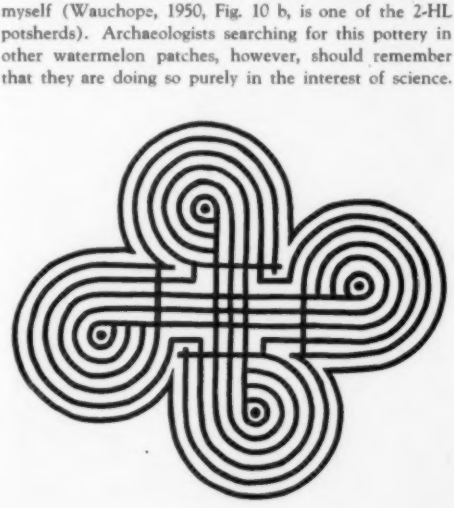

FIG. 137.

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August, 1952

FIG. 138.

UNUSUAL GEORGIA PETROGLYPH

This petroglyph (Fig. 138) was found about ninety years ago in Douglas County, Ga., on a hill on the north banks of Sweetwater Creek, not far from where this creek empties into the Chattahoochee River.

The petroglyph is quite different from any of the other known Georgia petroglyphs. The peculiar shape of the stone and the distinctive type of its markings make it one of the most interesting and rare examples of stone carvings in Georgia. The apparently purposely cut deep notch in the bottom of the stone is most puzzling and poses the problem of whether the stone might have been made to be placed upon a cross beam or a ridge pole.

The petroglyph is 44 inches high, 19 inches wide at the bottom and tapers to 14 inches at the top and the stone is approximately 12 inches thick. The design is deeply cut and greatly eroded but it roughly suggests a female skirted figure. Design appears on one side only, but there are small designs simulating hands or claws that tend to run over onto the sides of the stone. These claws are carved in position about where the arms of the figure should be and they are not cut nearly so deeply as the main design on the front of the stone. The rock is low grade granite of native origin and is much weathered.

In the vicinity of the original site of the petroglyph there are many low mounds not yet scientifically explored or studied. Many types of crude artifacts have been found on the surface around this location. There are unconfirmed reports of an ancient stone fort close by, which would bear investigation.

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A PLAINVIEW POINT FROM NORTHERN TAMAULIPAS*

Immediately after the exploration of the Santa Isabel Iztapan mammoth site in the Valley of Mexico had been completed (see pp. 332-40) the recently created Direccion de Prehistoria of the Instituto Nacional de Antropologia e Historia of Mexico undertook further reconnaissance in the reservoir basin of Falcon Dam on the Rio Grande. Work was concentrated on the Mexican side, where Aveleyra (1951) had located nine sites with abundant lithic materials.

The expedition in April 1952 consisted of: Luis Aveleyra Arroyo de Anda, archaeologist; Manuel Maldonado-Koerdall, paleontologist; and the senior writer. As on previous occasions, the reconnaissance was made in cooperation with the department of Research in Anthropology of the University of Texas, which conducted its work under grants from the National Park Service and the University. Archaeologists Alex D. Krieger and Joe

* Publication Number 3 of the Direccion de Prehistoria, Instituto Nacional de Antropologia e Historia, Mexico, D.F.

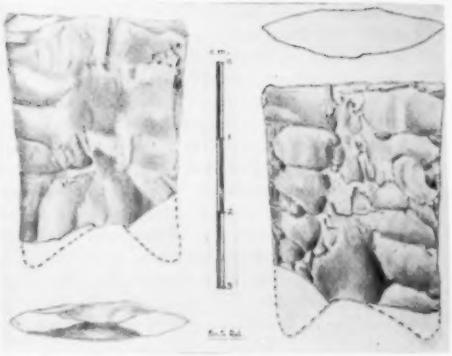

FIG. 139.

F. Cason, working on the American side of the reservoir basin, several times joined in discussions of many of the regional archaeological and geological problems.

Exploration on the Mexican side was done at several localities where concentrations of lithic materials were observed on and within the terraces of the Rio Grande and its principal tributary, the Rio Salado. Of special interest was the discovery of a new sector of the site previously designated number 9 (Aveleyra, 1951, p. 45), on the south bank of the Salado about two miles northeast of Ciudad Guerrero, Tamaulipas. This site contains the richest concentration of surface material of any site known on the Mexican side; and, moreover, shows an archaeological zone buried in the terrace about 20 inches below the present surface. Since, however, a great amount of stream and aeolian erosion is at present dissecting the terraces throughout the Falcon reservoir area, it is possible that the surface above the buried zone of site 9 was once appreciably higher than now. Extensive surveying will be needed before the geological position of this site can be correctly interpreted.

Artifacts which can be positively identified as belonging to any of the early man industries had not been found prior to the discovery mentioned below, although Krieger informs us that one fragment possibly of a Scottsbluff point was found in similar circumstances on the Texas side in 1950. The excavations of Cason in the spring of 1952 strongly suggested that the cultural zones he exposed within the higher terraces near the dam might be of considerable age. Therefore the finding of a Plainview point was not totally unexpected, but it is gratifying to have this type appear in Mexico, and it suggests what may be found with still further exploration.

On May 2, 1952, the two authors, accompanied by Krieger, Cason, and Williamson, again explored site 9, collecting artifacts from the surface and from the buried zone where exposed by erosion. The senior author found the basal half of a lanceolate projectile point in a place where it could hardly have come from any other cultural zone than the buried one. Although half the blade and the basal tips are missing, the edges are smoothed and it conforms in dimensions to the Plainview type first described by Sellards, Evans, Meade, and Krieger (1947) from the fossil bison quarry at Plainview.

The fragment (Fig. 139) is a very light brown, almost whitish flint, 23 mm. wide at the base, 24 mm. wide where broken, 6 mm. thick, and 30 mm. long. Although the flaking is rather crude, some tendency toward collateral chipping can be observed, without forming a median ridge on either face. The edges are nearly parallel, expanding very slightly toward the break, which must be approximately at the midpoint of the original specimen.

The basal concavity appears to have been rather pronounced, although the "ears" at the corners are missing, as shown by dotted lines in the drawing. Some of the small scars near the base show that this was thinned to facilitate hafting, a common feature of the Plainview type.

The broken places all show the same patina and coloration as the chipped surfaces, indicating that breakage occurred a long time ago.

The importance of this find is two-fold: (1) it represents the first Plainview point so far recorded from Mexico; and (2) it marks the southernmost occurrence of this type recorded in scientific literature. The writers are indebted to Krieger for the following information on the nearest points in Texas where this type has been noted:

1. The Frio River valley, in Frio, La Salle, and McMullen Counties, roughly 120 miles north-northeast of Ciudad Guerrero, has yielded definite examples of the type.

2. The Kincaid rockshelter near Sabinal, Uvalde County, 175 miles north of Ciudad Guerrero, excavated by the Texas Memorial Museum, yielded points similar to the Plainview type, as well as fluted points.

3. The Morhiss site 8 miles down the Guadalupe River from Victoria, Victoria County, about 200 miles northeast of Cuidad Guerrero, excavated by the University of Texas, yielded some fragmentary points which may be Plainview type.

It is hoped that future work of the Direccion de Prehistoria will continue to disclose more evidences of the southward extension of early lithic industries in the very promising field of northern and central Mexico.

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Mexico, D.F.
November, 1952

A FLUTED POINT FROM DURANGO, MEXICO*

Under the direction of J. Charles Kelley of Southern Illinois University, an anthropological field school carried out investigations in the State of Durango, Mexico, from June 22 to August 8, 1952, with the permission of the Instituto Nacional de Antropologia e Historia.

Their camp was established on the rancho "Santa Barbara," property of Fred Weicker, about 50 kms. west of Durango city, in the Sierra Madre Occidental. The camp was on the side of an arroyo, a branch of the Rio Mimbres, which after joining the Rio Chico, flows into the Rio Tunal. This becomes the Mesquital-San Pedro and flows into the Pacific through the State of Nayarit. The camp was approximately 2280 m. above sea level, near archaeological remains consisting of house-mounds, ceramics, and obsidian artifacts.

On the afternoon of July 1, Kelley found, near the excavations (Fig. 140), a projectile point on the ground which he at once recognized as a fluted point. Before moving it he called the other members of the field school to verify the discovery. The group then went over the surrounding ground minutely but found no other artifact of this kind, only surface materials clearly connected with the archaeological site on the hilltop.

Under the circumstances, Kelley considers the point as probably a secondary association; *i.e.*, that the fluted point was found somewhere and re-used by the later

* Publication No. 4 of the Direccion de Prehistoria, Instituto Nacional de Antropologia e Historia. Translated by A. D. Krieger.

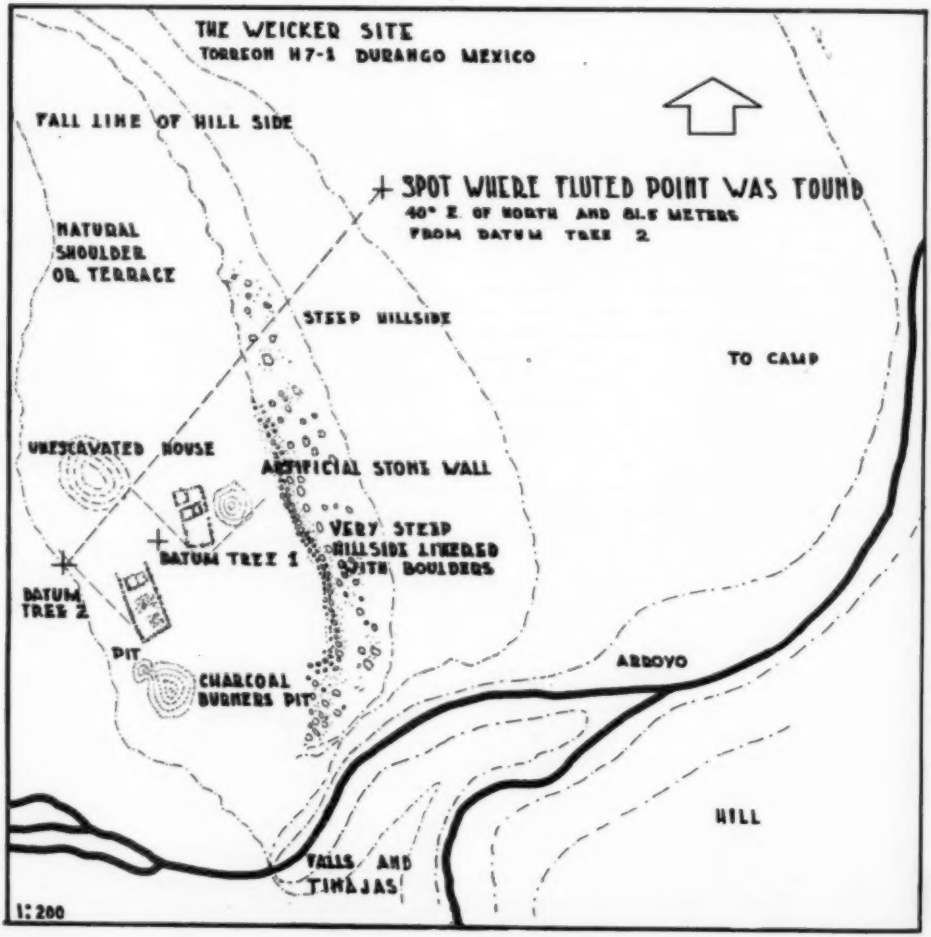

FIG. 140.

inhabitants of the hilltop. The same elements which transported the principal archaeological materials downward from the hilltop may therefore have carried the projectile point to where it was found. The point may also have been lost at this spot by its original owner. We are grateful to Kelley for furnishing his complete field notes.

The artifact is widest near the middle and tapers toward the base, where it widens again slightly at the basal corners or "wings." The fluting occupies about two-thirds the length of one face, slightly more than half of the other (Fig. 141). The specimen weighs 10.73 grams and has the following dimensions:

Maximum length	4.93 cms.
Minimum length	4.69 cms. (tip to basal concavity)
Maximum width	2.59 cms. at 2.09 cms. from tip
Minimum width	2.24 cms. at .67 cms. from basal concavity
Basal width	2.35 cms.
Maximum thickness	.80 cms. at 2.09 cms. from tip

According to data supplied by Ing. Eduardo Schmitter, Jefe del Departmento de Mineralogia y Petrologia, Instituto de Geologia, Universidad Nacional Autonoma de Mexico, the material is a normally crystallized quartz, opaque or only slightly translucent. [The Spanish is "cuarzo normal cristalino, de veta epitermal, con probable adularia," which suggests a fused and grainy quartzite rather than quartz crystal. ADK]. The crystallization is much more advanced than that of flint or agate, and the artifact shows adhesions, apparently of dolomitic clay.

The artifact must first have been blocked out with a percussion technique, then been more formally shaped and retouched with pressure flaking, which is regular along the edges and irregular on the faces. The flaking scars are 4 to 5 mms. in width, those of the channels (flutes) 7 to 8 mms., from which it is assured that different implements were used for the two kinds of flaking. Also the flutings themselves were not formed by lifting one large flake from each face, but two, by pressure, with retouching of the scars that were left.

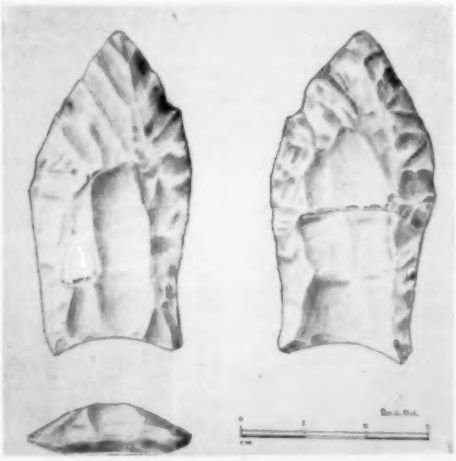

FIG. 141.

The smoothing of the edges in the lower middle part is rather difficult to recognize, for because of a probable erosive process their sharpness is somewhat dulled. Nevertheless, it appears that smoothing occupies the zone between the shoulders and small "wings" at the base.

As to typology, the size may place the point within the range of the Folsom group; but the general form permits its inclusion in the Clovis-Ohio group. The flutings correspond better with Clovis than with Folsom.[1]

The fact that this artifact was the only one of its kind found by Kelley's expedition, that it was in a surface position, and in the immediate proximity of a site inhabited in a relatively late epoch, does not rule out its implications of antiquity. Considering its characteristics, it is without doubt the most ancient type of projectile point so far found in Mexico.

[1] [Sr. Lorenzo has not specifically stated that the artifact had been re-fashioned, only "re-used." Kelley (letter to me, dated Jan. 31, 1953) states that "It appears to me to have been a longer point that was broken and had a new tip chipped on. As to its affiliations, Haury pointed out that, except for the re-chipping, it has almost exact duplicates in his series of eight projectile points found with the mammoth at Naco, Arizona, found in the spring of 1952, which he classifies as Clovis Fluted." Thus, while in its re-chipped state it may fall within the maximum size range of Folsom points, the features suggest that the original point would quite readily be included in the Clovis type. ADK]

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REPLY TO HOLAND

In the Autumn, 1951 issue of Archaeology magazine, H. R. Holand has voiced extensive criticism of my excavations around the Newport Tower as published in that periodical and in *American Antiquity*, Vol. 17, No. 2, 1951. Apart from many unfounded assumptions, Mr. Holand makes nineteen epistemological solecisms, most of which will be readily apparent to anyone with archaeological experience. Many of these points have been already refuted in my aforementioned articles.

There is no need to confute Mr. Holand on each point. It should be observed, however, that he pays but scant attention to my published articles, using instead a very preliminary report made only two weeks after the completion of the first season of excavation (1948). Material in this report was superceded by subsequent investigation and largely contravened.

Mr. Holand restates his contention that the tower measurements were based on the Rhenish-Danish-Norwegian foot of 12.35 English inches and not on the

English foot. It should be pointed out that his "careful measurements" are all based on only two composite measurements: the interior diameter of the tower (an average of four diameters), and the diameter of the columns (an average of sixteen diameters). None of the dimensions he uses is significant for two reasons: 1) the irregularity of the stonework precludes measurement more accurate than an inch or two, and 2) the whole tower was originally covered with a layer of mortar of irregular thickness, which has now disappeared. Measurements which have not been altered by these two factors, such as the diameter of the outside edge of the construction trench (30'6"), do not yield any uniformities when converted by Mr. Holand's formula.

Mr. Holand's final suggestion that the tower finds its prototype in cloistered sanctuaries such as that at Ghent merits little consideration. The Chesterton Tower in Warwickshire and other belvederes of the 17th Century are much closer to the Newport Tower as it originally appeared both in style and function.

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JAMAICAN SITE DESIGNATION — A CRITIQUE

In designating archaeological sites it has become customary to use one or the other of two general methods. The first, such as the system used by the River Basin Surveys, makes use of numbers and letter abbreviations which together give ready reference to state, county, and site number. A second method has been to name a site after some cultural or geological manifestation associated with the site. Discussions regarding the relative merits of the two methods have for the most part focused upon the degree to which either system lends itself to the efficient manipulation of areal data.

Most archaeologists are probably familiar with this question and the efficiency aspect of it is of no concern here. Rather, this critique is concerned with the propriety of employing a certain Jamaican site designation. Namely, "Little Nigger Ground Hill Site" (De Wolf, 1953, pp. 230-238).

It is immediately apparent that the use of this site designation is to be criticized on the grounds that it carries with it numerous connotations which are deeply offensive to a large number of people. Duerden made the original error in 1897 when he selected this name rather than its local alternate — "Cacique's Ridge" (Duerden, 1897, p. 19). De Booy repeated the impropriety in 1913 (De Booy, 1913, pp. 425-434). This precedent, however, seems to be a meager reason for perpetuating the offense in the anthropological literature of 1953.

Future work in Jamaica as well as in other areas with colonial histories will undoubtedly meet with this problem again. It is suggested that the archaeologists concerned will give some thought to the connotations of local names before perpetuating them in publications.

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February, 1953

A METHOD OF CALCULATING THE DIETARY PERCENTAGE OF VARIOUS FOOD ANIMALS UTILIZED BY ABORIGINAL PEOPLES*

The renewed activity in Plains Archaeology as a result of the salvage program of the River Basin Surveys of the Smithsonian Institution and cooperating agencies has reemphasized some very striking differences in the types of animals used for food by prehistoric peoples. Some groups, such as the Woodland and Upper Republican, set an extremely varied "table" while others appear to have subsisted almost entirely on one species of food animal. With those groups which subsisted on a variety of game, the question naturally poses itself: "What percentage does each species contribute to the diet of the people?" Although complete data on the "dressed-out" weights of the various food animals found in archaeological sites is not available, calculations based on the data and procedure outlined here should provide a means of arriving at a reasonably reliable answer to the above question.

The numerical count of the bone from an archaeological site is dependent on the length of occupation, rate of sedimentation, size of the excavation, and accidents of preservation. Also, some of the small mammals like ground squirrels and small birds may have been eaten whole, but aside from such exceptions the bones of one food animal have as good a chance of being preserved as those of another. On this basis it is felt that an excavation which meets the archaeological requirements will provide a suitable cross-section of the variety of food animals used, and furnish an adequate sample to calculate the percentage which each species contributes to the diet of the people.

A percentage computed from the gross count of identifiable bone will not give reliable results because, with large animals like the bison, most of the metapodials, pelves, vertebrae and skulls are left at the kill

* Published by permission of the Secretary of the Smithsonian Institution.

while deer and antelope were probably brought to the village for butchering. Also, a percentage calculated from the number of individuals of each species as represented by the greatest number of any one element will give erroneous results because of the difference in size between the species. A brief examination of the accompanying table will show that four deer will be required to provide as much meat as one bison cow. In order to avoid the above errors it will be necessary to compute the total meat furnished by each species found in the site and this result expressed as a percentage of the total meat represented by all of the species from the site.

In order to determine the amount of meat furnished by any given species, it will be necessary to determine the number of individuals represented by the excavation sample. The method I have used in the studies on butchering technique is to separate the most abundant element of the species found (usually the distal end of the tibia) into right and left components and use the greater number as the unit of calculation. This may introduce a slight error on the conservative side because, without the expenditure of a great deal of time with small return, we cannot be sure all of the lefts match all of the rights. To use the total components of the most abundant element and divide by two would introduce greater error because of the possible differential distribution of the kill (unless the site is completely excavated). In all of the sites from which I have identified the bone, and also all of the features in the sites, the right and left components of the elements were never equal and the differences are usually too great to be accounted for by accidents of preservation.

After the number of individuals of any species in the sample has been determined this number should be multiplied by the number of pounds of meat which one individual of the species in question will yield upon butchering (see table). This will give the total meat for that species in the site. The procedure must be repeated for all of the species in the site.

The statement is often made, and is essentially true, that with certain animals prehistoric peoples utilized the entire carcass. The meat packers also boast that they utilize everything but the squeal of the pig. At the same time, according to standard textbooks on Animal Husbandry, they state that only 60 per cent of the live weight of prime beef, 50 per cent of stock beef, and 70 per cent of the pigs are suitable for the table, the remainder going into by-products such as fertilizer, leather, soaps, and glue. Consequently, in any dietary study it is necessary to distinguish clearly between that portion of the animal *used for food* and that used for utensils and clothing.

On the basis of the amount of bone found in archaeological sites, it is presumed that the prehistoric peoples were not as efficient in the manufacture of by-products as the meat packers and, correspondingly, it is doubtful if the percentage of usable meat obtained by their methods of butchering will run as high. On the other hand, the error should remain relatively constant and the percentages obtained by the meat packers should give reasonably accurate results for prehistoric peoples. It is doubtful if any of the wild game animals of the cattle-sheep type would be classed as prime by the meat packers; consequently, in compiling the following table, I have used the percentage given for stockers and feeders (50 per cent). Into this group bison, elk, deer, and antelope will naturally fall. Raccoons, badger, beaver, prairie dogs, etc., will fit into the group with the heavy-bodied, short-legged pigs which yield 70 per cent of the live weight as usable meat.

In compiling the following table I have taken the average live weights when given, otherwise they have been calculated from the maximum and minimum weights given. Since it is usually impossible to determine the sex of the animals found in archaeological sites from the elements recovered, the separate weights are not given unless the average weight of the male is nearly twice that of the female. If the weight of the female is only 25 or 30 per cent less than that of the male, the two weights are averaged. Also, the weights of exceptionally large individuals have been excluded from the calculation. The amount of usable meat was calculated from the average live weight according to body form, using the percentages given above.

In compiling this list I have included the North American mammals and birds large enough to be important food animals for which the average live weights were given. In some cases, as with the seals, only the weights of the males were given with the statement that the females were much smaller. Turtles and fish have been omitted from the list because of the lack of data.

TABLE 14.

Mammals	*Sex*	*Average Live Weight*	*% of Usable Meat*	*Pounds of Usable Meat*
Bison	♂	1800	50	900
	♀	800	50	400
Musk-ox		600	50	300
Bighorn Sheep		200	50	100
Mountain Goat		200	50	100
Peccary		50	70	35
Elk		700	50	350
Virginia Deer		200	50	100
Mule Deer		200	50	100
Moose		800	50	400
Caribou		250	50	125
Antelope		110	50	55
Raccoon		25	70	17.5
Coati		15	50	7.5
Ringtail		2.5	70	1.75
Otter		18	70	12.5
Sea Otter		80	70	56
Skunk		7	70	5
Badger		18	70	12.5
Red Fox		8	50	4
Gray Fox		9	50	4.5
Arctic Fox		9	50	4.5
Coyote		25	50	12.5
Wolf		60	50	30
Opossum		12	70	8.5
Black Bear		300	70	210
Grizzly Bear		650	70	455

TABLE 14 (Continued)

Mammals	Sex	Average Live Weight	% of Usable Meat	Pounds of Usable Meat
Polar Bear		850	70	600
Armadillo		15	50	7.5
Cougar		120	50	60
Jaguar		200	50	100
Ocelot		30	50	15
Jaguarundi		15	50	7.5
Lynx		30	50	15
Woodchuck (*Marmota monax*)		8	70	5.6
Rockchuck (*M. flaviventris*)		12	70	8
Ground Squirrels (*Citellus*)				
columbianus group		1.5	70	1
tridecemlineatus group		0.5	70	0.35
variegatus group		1.5	70	1.0
Prairie Dog		2	70	1.5
Pocket Gopher		1	70	0.7
Packrat		1	70	0.7
Beaver		55	70	38.5
Water Rat (*Neofiber*)		0.75	70	0.5
Muskrat (*Ondatra*)		3	70	2
Mountain Beaver (*Aplodontia*)		2.5	70	1.7
Porcupine (*Erithezon*)		15	70	10
Varying Hare		3	50	1.5
Arctic Hare		9	50	4.5
W. T. Jackrabbit		6	50	3
B. T. Jackrabbit		6	50	3
Cottontail		3.5	50	1.75
Furseal	♂	400	70	300
Steller Sea Lion	♂	1600	70	1300
	♀	450	70	315
California Sea Lion	♂	500	70	350
Greenland Seal	♂	600	70	420
Bearded Seal	♂	800	70	560
Elephant Seal	♂	5000	70	3500
Walrus	♂	2000	70	1400
	♀	1400	70	980
Manatee		1000	70	700

Birds	Sex	Average Live Weight	% of Usable Meat	Pounds of Usable Meat
American Merganser		3.0	70	2.1
Blue Goose		5.2	70	3.5
Greater Snow Goose		6.5	70	4.5
Lesser Snow Goose		5.0	70	3.5
Canada Goose		8	70	5.6
Cackling Goose		4.0	70	2.8
Brant		3	70	2.1
Wood Duck		1.5	70	1.0
Trumpeter Swan		25	70	17.5
Whistling Swan		15	70	10
Pintail		2.0	70	1.4
Canvasback		2.7	70	1.9
Black Duck		2.5	70	1.75
Mallard		2.5	70	1.75
Lesser Scaup		1.8	70	1.25
Green-winged Teal		13 oz.	70	9 oz.
Sage Grouse	♂	5.5	70	3.8
	♀	2.6	70	1.8
Wild Turkey		12	70	8.5
Sharp-tailed Grouse		2.0	70	1.4
Scaled Quail		7 oz.	70	5 oz.
Bobwhite		6 oz.	70	4.2 oz.
California Quail		6 oz.	70	4.2 oz.
Mountain Quail		8.2 oz.	70	5.7 oz.
Gambel's Quail		6 oz.	70	4.2 oz.
Mourning Dove		4.5 oz.	70	3.2 oz.
Woodcock		7.5 oz.	70	5.2 oz.

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Excavations in Big Hawk Valley, Wupatki National Monument, Arizona. WATSON SMITH, with an appendix by GEORGE ENNIS. Bulletin 24, Museum of Northern Arizona, 1952. vi + 203 pp., 50 figures, 16 tables.

This monograph is an account of excavations and research performed in 1948, under the auspices of the Museum of Northern Arizona, at six sites northeast (not northwest as stated on p. 1) of Flagstaff, Arizona. Not only are the tabulations and descriptive text of high caliber, but the analyses and fully reasoned topical discussions are lucidly presented, instructive, and of considerable interest and value, both factually and from the standpoint of theory and method, e.g., the brief evaluation of sherd analysis on the basis of weight as opposed to quantity. Technically the publication is excellent, especially the photographs. However, as unfortunately is not uncommon in the publications of the Museum of Northern Arizona, the editing is far from meticulous. Despite the issuance of a full page of errata and omissions, there remain not a few editorial oversights and printer's mistakes. I know that I am not alone in wishing the Museum would take more care with their valuable and otherwise admirable publications.

After a brief orientation in the local geographic and cultural (taxonomic) contexts, the bulk of the report consists of descriptive and comparative studies of the sites and of the cultural remains recovered. There follows an enlightening and very pertinent exposition of the problem of "When is a Kiva" and finally a chapter of "Recapitulations and Conclusions" which places the sites in their temporal and taxonomic positions and suggests the cultural conditions which could, and might actually, have obtained at the time of occupation. There are three appendices: on burials, on animal bones, and the last by George Ennis on the metrical characteristics of the human skeletal remains.

Four of the sites contained features exhibiting an "obvious correlation" with the so-called unit type dwelling described from the Four Corners region by Prudden: each consisted of a multi-roomed surface structure, subterranean room(s), and a courtyard or plaza enclosed either by a surrounding wall or by two wing-walls extending from the corners of the surface building. These sites yielded ceramic clues which led Smith to postulate a three-fold, sequential occupation during the first half of the 12th century, first by Sinagua people, then by Cohonina people, and finally by people possessing a Kayenta branch pottery complex (p. 173).

I am not at all sure that this rather elaborate hypothesis of three separate occupations is justified by the data adduced to its support, especially in the light of the magnitude of ceramic importation in other sectors of the Southwest as demonstrated by Anna Shepard's penetrating studies. Furthermore, Smith himself says that "there is no certainty that the surface houses and the pithouses at these sites necessarily belong to each other as parts of the same occupational unit," although their arrangement and pottery correlations suggest that they do (p. 174). Yet in the face of these possible doubts and admitted uncertainties, one potentially very valuable archaeological technique was not employed. No trenches were dug *between* the units of each site, whereby the structures could have been physically joined through the earth profiles existing in the ground between them.

I have mentioned this one sin of omission because, far from being peculiarly Smith's, it is a definite characteristic of Southwestern archaeological practice in general. I know of no other way by which empirical, as opposed to inferential, relationships can be established between the several separate units of a Southwestern site, yet the technique of inter-mural trenching is rarely practiced, and then usually incompletely and incidentally. Despite clear evidence that connecting trenches and the resulting depositional profiles have proved of great value in the archaeological work of the eastern and southeastern United States, Southwesternists continue to deal with their aboriginal sites in terms of discrete, even isolated units. Pithouse village after pithouse village has been dug, surface structures with associated outbuildings have been excavated, yet little or nothing has been done to intra-connect these wholes by the only technique which can do so physically, empirically.

Southwesternists have shown themselves to be strongly object minded. They readily infer relationships on the basis of material objects, individually and quantitatively (typologically), but they apparently fear to do so on the basis of data of a relational sort, even when the latter is grounded on more empirical fact. If I am right in this interpretation, I believe that we can attribute to it the scarcity of detailed studies on wall construction and sequence, the scarcity of soil and depositional profile studies, the scarcity of studies relating cultural conditions to environmental ones thereby developing thoroughgoing culture-environment investigations, and possibly many more such omissions in the discipline of *Archaeologia*, var. *southwest*. Southwesternists appear to be interested primarily in those birds which they can hold in the hand, and they often fail to consider the data to be derived from the relationship(s) existing between those other birds and the bushes wherein they sit.

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Excavations at Nebaj, Guatemala. A. LEDYARD SMITH and ALFRED V. KIDDER. With Notes on the Skeletal Material by T. D. STEWART. Carnegie Institution of Washington, Pub. 594, Washington, 1951. Pp. viii + 90, 90 figures.

This excellent compact volume presents the results of excavations in two mounds of the Nebaj ruins near an Ixil Maya town north of the Rio Negro and a high eastern extension of the Cuchumatanes in the Department of El Quiche. During parts of three field seasons,

A. L. Smith and his associates obtained a wealth of archaeological data on highland cultures from the early Classic into the post-Classic stages.

Having visited Smith's excavations in 1947, I can say that his report modestly understates the highly complex stratification and the technical difficulties encountered during the digging. For example, in two unemotional sentences, Smith reports a heartbreaking situation that changed the excavation from an originally-planned one-season job to a major undertaking. At Mound 2, he had located the tomb's ramp running down through the frontal platform, followed it to the stone slab entrance, removed this and exposed, literally within arm's reach, the burial chamber and its rich contents. "Unfortunately" (a word Smith must have chosen with almost unbearable restraint), the capstones and part of the corbeled vault had fallen and the mound fill above the chamber was dangerously loose. To have proceeded would almost certainly have added more sacrificial victims to the tomb's already somewhat crowded skeletal population. Smith had to back out and come down 12 meters from above, through a bewildering goulash of six superimposed stairways associated with a sequence of frontal platforms, 21 caches, four incidental burials, nine other tombs, and assorted archaeological features.

These difficulties were of course in the long run scientifically rewarding, for they forced a stratigraphic study that adds much to our knowledge of Maya archaeology. They established a sequence of tomb types and burial methods and they shed much light on highland development and relationships over a period of perhaps 400 years. About half of the volume is devoted to concise description and discussion, by Kidder, of the artifacts: pottery and alabaster vessels, incense burners, figurine whistles, jade beads, pendants, and plaques, shell ornaments, pyrite-incrusted plaques, flint and obsidian objects, copper bells, gold ornaments, painted plaster, and various animal and bird bones. The studies of jade and of pyrite-incrusted plaques are particularly valuable, not only for typological use but for their wider implications. For example Kidder and Proskouriakoff share the belief that some of the jades were the product of a single Usumacinta school active during a relatively short period near the close of the late Classic. The abundance of pyrite-incrusted plaques "proves beyond doubt that those communities enjoyed an economy sufficiently secure to permit many craftsmen an enormous amount of time in the production of objects which, from our point of view at least, had no utilitarian value."

Forty-six excellent plan and section drawings, plus two tables, enable Smith to hold his section on "Field Work" to twenty pages of concentrated, synthesized data on the dirt archaeology. Forty-four collotype figures with full captions similarly relieve Kidder's section on "Artifacts" of all but the analytical material. Format throughout is enviable; the one minor editorial slip I ran across (page 57, line 28) is probably the result of a changed decision to render the frontispiece in natural color, which is, incidentally, a superb rendering by Proskouriakoff of late Classic stucco painting.

Both Smith (in his introduction) and Kidder (in his discussion) display constant interest in the socio-cultural implications of their data. The absence of pre-Classic remains suggests to them that Indians in this area may then have been backward people, leaving inconspicuous remains, or tribes in a rugged country resisting acculturation and contacts with more advanced neighbors. Imported late Classic Peten pottery in early Classic Nebaj tombs suggests further cultural lag here, and either local or certainly highland roots for the Nebaj Classic stage. Smith feels that the inhabitants at this time were probably Maya-speaking Ixil. Both authors see at Nebaj further expression of the Classic Mesoamerican patterns of theocratic, hierarchical and autocratic government, with wide cleavage between upper classes and commoners, highly developed ritual, prosperity (as revealed in luxury goods), relatively peaceful conditions (open defenseless cities, widespread trade, prosperity). Kidder modifies the last to admit, perhaps, clashes between principalities, wars "in the nature of semi-sporting events from which the survivors on both sides retired with heightened prestige," but the concept of empire did not yet exist, apparently, nor was *Lebensraum* yet a cause for war. Lack of pressure by less cultured groups, a slowly increasing population with abundant land, a reliable food supply, and probably freedom from devastating epidemics, may have made possible the Classic development.

Kidder presents some interesting speculations as to motivations of the hierarchs themselves, in their frequent large-scale building and remodeling of ceremonial structures. If they did not build merely to keep people occupied, Kidder suggests that they considered the labor itself an offering to the gods, and the erection of a temple thus an act of piety, a hypothesis that would make more understandable the apparently "irreverent" reckless violation of both tombs and structures that accompanied such alterations.

Both Smith and Kidder point out that post-Classic trouble was brewing elsewhere, and that it is important to know relative chronology for such places as Nebaj, Tula, Tajin, Monte Alban, and the lowland cities. Group A ceased to be a ceremonial center eventually, but tombs yielding Tohil plumbate reflect some prosperity carrying over into post-Classic times here. Did bellicose Mexican groups invade the highlands after the fall of Tula? Did the Maya Ixil fall under the domination of Mexican-influenced Quiche? The wholesale movement of highlanders to fortress sites, later, reflects the full impact of militarism in protohistoric times; what led to this, in the intervening post-Classic period, remains one of the important unsolved problems of anthropological and historical interest. So long as archaeological reports display the awareness of these matters that Smith and Kidder's Nebaj volume shows, we can hope that such questions will not go forever unanswered.

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Piedras Negras Archaeology: Architecture. Part V: Sweathouses. LINTON SATTERTHWAITE, JR. University Museum, University of Pennsylvania, Philadelphia, 1952. 91 pp. 69 figures.

This is a comparative study of Middle American sweathouses, ancient and modern, drawing on archaeological, documentary, and ethnographic sources. Its purpose is the determination of criteria by which such structures can be recognized, for in 1935, when the Piedras Negras examples were only suspected of being sweathouses, the documentary sources had given the widespread impression that sweat-bathing must have been introduced to most Mayan groups by outsiders, in relatively late (post-Classic) times.

Satterthwaite first isolates and defines, from modern and historical data, specific sweathouse traits. The Piedras Negras structures provided additional features. He then analyzes this material and produces trait linkages or function complexes: those traits clearly suitable for drainage, for heat and/or steam production and retention, and others. There follow detailed mound-by-mound descriptions, discussion of how unexcavated sweathouses can be recognized, and a review of their archaeological distribution.

Sweathouses were essentially curative in function, but the cure was partly magico-religious. A considerable body of traditional lore probably governed their particular uses. Bathing with water was also practiced in the sweathouses, and Satterthwaite prefers the terms "sweat-room and bathroom" to "steam-room" until one has definite proof of the use of steam in the pre-Conquest and Conquest-time examples. He also feels that we should be careful to distinguish between "drains" and "sunken passages," although the latter may also serve as drains.

The data are presented in a convenient order that enables the non-specialist to find a statement of the problem, the methodolgy, the conclusions, and even a bibliography without reading farther than Chapter 1. I expect, however, that traditionalists may object to this arrangement, for I remember that there was some adverse review criticism of my 1948 Zacualpa report on these grounds. A few perfectionists also continue to look down their aesthetic noses at the offset process by which this important Piedras Negras series is being reproduced, but the text is easy to read, the line drawings are excellent, and the photographic illustrations (often the weakest feature of offset) are as clear as one could want. Certainly the abundance of tables and illustrations was made possible by the budgetary savings that offset printing effects.

The importance of this monograph becomes more apparent when we ask ourselves: Of how many Maya structures do we know the precise, real function? Ballcourts and now sweathouses are pretty sure things, but very few (if any) housemounds can be surely demonstrated as such, dance platforms are only so-called, it is largely speculative what actually went on in pyramid-temples, and the precise "civic-religious" function of the vast majority of other structures that make up the bulk of city architecture is wholly unknown. I have perhaps overstated this, for we do know to what deities certain temples were dedicated, some structures seem to have astronomical significance, there are a few "throne rooms," some sealed chultuns with paved drainage platforms were doubtless reservoirs, and so on, but in few cases are we on quite so sure ground as we now are with sweathouses, thanks in the last category to the studies of Morley, Ruppert, Cresson, Mason, and most of all, Satterthwaite. The Usumacinta cities, with their demolished thrones, their fine pictorial sculpture and ethnographically valuable murals, their royal tombs and unusual subterranean stairways and chambers, their "schools" of art, their lengthy hieroglyphic texts, and their sweathouses, seem to be contributing more than their share of materials suited to socio-cultural interpretation.

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Four Late Prehistoric Kivas at Point of Pines, Arizona. TERAH L. SMILEY. University of Arizona Bulletin, Vol. XXIII, No. 3, Social Science Bulletin No. 21. Tucson, 1952. 72 pages, including 12 plates, 9 figures. $0.75.

This study adds another to the growing list of documents resulting from the work of the University of Arizona in the Point of Pines area. The importance of this paper is two-fold. First, it gives documentation of the consistent presence of kivas in an area where they were not believed to occur; and second, it explores the cultural dichotomy of eastern and western Pueblo areas, which maintain parallel, but often materially different, sets of culture traits.

A brief preface summarizes the environmental background of the Point of Pines area. This is followed by a short introduction outlining the development of an hypothesis that certain isolated depressions near the large late pueblos contained kivas. The testing of that hypothesis resulted in the excavation of four late kivas with which the study is concerned.

The main body of the paper is divided into three parts, the first being a discussion of the Western Pueblo Kiva Complex. Smiley concisely reviews the ethnological and historical data bearing on kiva organization and use. He surmises that recent usage must have had its origin in the usage of the past, but he clearly points out that specific social or religious organization cannot be inferred from the nature of the kiva.

After defining the term *kiva*, Smiley discusses the generalized structural similarities between modern Hopi and Zuni kivas and the prehistoric kivas at Point of Pines. The parallels are viewed, also, in the light of what is known concerning the movements of the Pueblo Indians, especially during Pueblo IV times. The question is raised as to whether all cultural parallels are the result of migration, and a suggestion is made that at least some similarities may have arisen from

the influence of only a few Indian guides, slaves, or converts, who accompanied the Spanish explorers in early historic times.

The development of the rectangular kiva is discussed in relation to its differentiation from the circular kivas. Architecturally, they can be traced from Betatakin, Keet Siel, and the Flagstaff "frontier" area of the 12th and 13th centuries, through Pinedale, Point of Pines, and Hawikuh, into modern Zuni and Hopi. The author suggests that the mixture of rectangular and circular kivas in the Rio Grande area is due to the movements of peoples and ideas. The origin of the kiva, as such, is also considered. It is pointed out that, while there is no doubt that the small circular kiva developed architecturally from the earlier pithouses, the concept may well have been introduced from the south. There will undoubtedly be some who object to Smiley's suggestion that the institution of the Great Kiva, and perhaps the idea of a small kiva, as well, were diffused northward from the Mogollon to the Anasazi. However, the burgeoning of facts supporting such a view cannot be lightly dismissed.

The second part of the study is concerned with a detailed description of the four late Point of Pines kivas and their contained artifacts. Two of these are at the site Arizona W:10:52, and one each at Arizona W:10:47 and W:10:48. All conform to a generalized type. They are located away from the main pueblo, to the east. All are subterranean and rectangular. Across the south or southeast side is a platform, beneath which passes a ventilator shaft. In addition, one kiva has narrow benches along the north and south walls. Each has a rectangular slab-lined fire place, but no deflectors were found. Shallow depressions, perhaps for offerings, occur in front of the mouth of the ventilator shaft in three of the kivas, the fourth having an ash pit instead. Only three have sipapus. Flagstones covered one floor and part of another, while the remaining floors were finished with plaster. Veneer masonry was used in three cases, with the fourth (and earliest) having only heavily plastered walls. Evidence for a loom anchor was found in only one kiva, wall niches occurred in two, and two had ladder holes in the floor. Three had grinding stones set in the floor to the right of the ventilator opening. A most interesting feature of one kiva was a series of grooves radiating from the fire pit.

Following the detailed description of each kiva is a section headed "Discussion and Integration." Here Smiley brings together all available data bearing on distribution and relationships of traits found in the Point of Pines kivas, thus pointing up their significance in the areal picture.

The third main section, "Dating the Kivas," places the Point of Pines structures in their chronological context and, in addition, furnishes a most useful study of modern dating techniques of both sites and pottery types by dendrochronology and cross-dating. Since no dendrodates were obtained from the kivas, and only two from the Point of Pines area, cross-dating had to be employed. Smiley's review of the tree-ring dating of such pottery types as Four Mile Polychrome, Kinishba Red, Pinedale Polychrome, and Gila and Tonto polychromes is outstanding. It is considered that the Point of Pines kivas ranged in time from about A.D. 1300 to 1400+, when they were abandoned.

A brief summary and bibliography conclude the study.

The format follows the standard of the University of Arizona Press. Typography and layout are generally good. However, a number of misprints mar the paper, and in a few cases are confusing. It does not much alleviate the situation to know that the misprints are not the fault of the author. Reproduction of the plates is uniformly poor, but the figures are well drawn and clearly printed. The practice of giving page and figure numbers when giving a reference should aid in following the discussion.

This study clearly marks an advance in our knowledge, not only of kiva construction and history, but of western Pueblo archaeology, as well.

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Woodland Sites in Nebraska. Marvin F. Kivett. Nebraska State Historical Society, Publications in Anthropology, No. 1, 1952, Pp. 102, 30 plates, 6 figures.

This paper reports the results of excavations at five Woodland sites in three widely scattered districts in Nebraska. Two of the sites are located in Hitchcock County, on the Republican River; one is in Hooker County on the Middle Loup, in the Sandhills of central Nebraska; and two are in the Loess Plains of Platte County, in eastern Nebraska. The Platte County sites were excavated in 1941 by WPA labor under supervision of A. T. Hill, former Museum Director, to whom the volume is fittingly inscribed. The other three were investigated during 1949 and 1950, as a direct result of the federal government's water-control program.

All of the sites consist of former occupation areas buried beneath a few inches to several feet of sterile overburden. In one instance, the overburden included an overlying cultural stratum in which were prehistoric sherds and later contact materials, the latter possibly attributable to a late (Pawnee?) hunting camp. Features usually present in the Woodland levels included hearths, pits, basins, occasional postholes, and burials. Some of the basins may represent former habitations, inferentially of light construction and quite unlike the well-marked earthlodges used by later prehistoric and historic peoples of the region. Burials seem to have been usually flexed and in dug pits, with few or no offerings. Artifacts were nowhere abundant; they consisted chiefly of pottery of several rather distinct varieties, a few chipped stone implements, and occasional bone and shell objects. The animal bone refuse suggests mainly smaller mammals and birds rather than bison. Direct proof of domesticated plants, in the form of charred corn, was

found at but one site, in Platte County; and implements clearly designed for cultivation were absent.

The general picture one gets from these reports, as from previous papers on Plains Woodland cultures, is that of small population aggregates — family units, perhaps, living in relatively frail habitations, subsisting largely by hunting and gathering with little or no agriculture, and with very limited industries in bone, stone, shell, and other durable materials. This is in marked contrast to the mode of life and cultural inventories inferred for the later, patently semi-horticultural, groups that inhabited the same localities.

The artifacts and features found at each of the sites are generally adequately discussed, and a good many of them are illustrated. In the reviewer's opinion, the resume presents a well-reasoned and conservative interpretation of the possible meaning of the findings in terms of the native economy, community life, and other non-material aspects of Plains Woodland culture.

It has long been evident to workers in the region that there were consistent, if not always easily described, variations in the materials generally termed Woodland. As one might suspect, therefore, the relatively limited ceramic and other artifact materials herein considered show sufficient variety to warrant, in Kivett's opinion, their placement in several different groups or foci. The Woodland component at the Carmody Site, Hitchcock County, is assigned to the Keith focus; the nearby Massacre Canyon site shows similarities to Keith focus, but may actually belong to another as yet undefined variant. The deeply buried Kelso site, in Hooker County, tentatively "may be assigned to the Orleans aspect with the Valley and Keith foci." The two Platte County sites, whose ceramics interestingly resemble those of Keyes' Missouri Bluffs focus in Iowa and also those from Eagle Creek in northeastern Nebraska, have been termed the Loseke Creek focus. The chronological relationship of these several variants is not altogether clear, although it would seem likely that the Loseke Creek materials are relatively late in the Woodland horizon. The Valley focus appears to equate approximately, or in part, with the Kansas City Hopewell horizon. Just where the Keith focus belongs is uncertain.

I suspect that some will find Kivett's discussion of the various Woodland manifestations somewhat confusing, because it assumes too much information on the reader's part. To some extent, this is probably due to the fact that Kivett's views have been set forth in somewhat more detail in another paper which he now has in press at the Bureau of American Ethnology, and which he understandably expected to see in print before the present publication made its appearance. It would have been helpful in the volume under review, nevertheless, to have included somewhere a summary statement setting forth clearly and concisely the traits regarded as characteristic of each of the foci and the larger taxonomic divisions discussed.

On the whole, the author has done a good job with the relatively limited materials available to him; and his paper is a most welcome and useful addition to the growing literature concerning itself with the earliest ceramic cultures of the Nebraska region — cultures which appear also to be widely distributed elsewhere in the central Plains. As the first of a new series of papers designed to make available the results of hitherto unpublished materials in the Historical Society's extensive collections and files, it is most promising. The format is good, the editing well done, the illustrations above reproach, the price reasonable. All those interested in furthering an understanding of Plains prehistory will wish the Society and its staff well in its new undertaking, with the further hope that the new series may be a long one.

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BOOK NOTICES

Molluscan Species in California Shell Middens. ROBERT E. GREENGO. Reports of the University of California Archaeological Survey, No. 13, December 10, 1951. i, 23 pp., 1 fig., 16 tables. Berkeley.

The author has given detailed results of shell sampling of six middens in Central California and has drawn on data from six additional sites in the area. There is discussion of inferred shell and species content of sites in the Santa Barbara area in California, the North Pacific Coast (Washington), the Baltic, Japan, and the Northeast and Florida. He drew on the Californian work of E. W. Gifford, N. C. Nelson, S. F. Cook, and A. E. Treganza in regard to sampling of shell middens in his area. His techniques are adequately described. The molluscan nomenclature is up to date; future workers will be thankful. Data drawn from works of some scholars in other fields (A. S. Knox, R. P. Goldthwait, F. S. MacNeil, G. E. MacGintie, J. Steenstrup, U. S. Grant, etc.) support his arguments and conclusions. In general, Mr. Greengo's M. A. thesis is a substantial contribution to shellmound archaeology and not only for California. Sample collecting (sometimes collecting again) and the amount of museum analysis must have been a tremendous undertaking as a part of normal graduate studies. His conclusions are general and seem to bear out some theories of physiographers and students of shorelines.

Factors reflected in shellmound archaeology are discussed: fire building habits, seasonal camping, shellfish gathering methods, proportions and importances of other foods as inferred from other zoological remains in middens, usually (?) inedible mollusk species and not eaten species in marine middens. The ecological treatment of some species of marine mollusks encountered in sites reported upon is good.

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Hermosillo, Sonora, Mexico.

Exploitation of Land in Central Mexico in the Sixteenth Century. LESLEY B. SIMPSON. Ibero-Americana 36, University of California Press, 1952. Pp. 92, incl. 30 maps and 5 graphs. $1.50.

In a previous study (S.F. Cook and Lesley B. Simpson, *The Population of Central Mexico in the Sixteenth Century*, Ibero-Americana 31, University of California Press, 1948) it was found that the Indian population of the Audiencia of Mexico — the territory between the Chichimec frontier and the Isthmus of Tehuantepec — declined by as much as 80 per cent during the sixteenth century. In this article, which is an outgrowth of the previous study and complementary to it, it is pointed out that since most of this population was agricultural it follows that something like 80 per cent of the agricultural land was progressively vacated — and was largely taken over by livestock: "the conquest made inevitable an ecological revolution of truly vast proportions, the consequences of which permanently and profoundly affected the Mexican landscape and the structure of society" (pp. 1-2). The story is summarized in one graph, the frontispiece, indicating that as the human population dropped from over 6,000,000 before 1540 to less than 2,000,000 in 1620, the number of cattle rose to a million and of sheep and goats to 8,000,000. Pages 1-26 discuss this generally and hint briefly at the sociological and ecological effects of this tremendous change; then the agricultural activities of twenty-nine subdivisions of the region are summarized in tabular form with occasional comments. The data presented are interesting, or, rather, tantalizing: this little monograph is the bare framework of what could be a fascinating and significant extensive study in historical geography of Mexico.

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Papers in California Archaeology: 17-18. Includes "A survey of cave archaeology in California," ROBERT F. HEIZER (*Papers in California Archaeology: 17*, pp. 1-12 and 1 map); "Excavation of Sis-13, a rock-shelter in Siskiyou County, California," WILLIAM J. WALLACE and EDITH S. TAYLOR (*Papers in California Archaeology: 18*, pp. 13-39 and 3 plates). *Reports of the University of California Archaeological Survey, No. 15*, University of California, Berkeley, 1952.

In Paper No. 17, Dr. Heizer presents a brief survey of published material on caves containing archaeological material in California. Following a few remarks on each of the areas in California where caves have been found, he gives a few general considerations to the possible significance of caves to California archaeology. Only a small amount of such material has been reported on to date, and there has been little effort to use the data on basketry and other material in broader studies. There is also a section on recent use of the caves by California Indians and mythological references to caves. There are still many areas in California which should be surveyed for caves. These include parts of San Bernardino, Riverside, San Diego, and Imperial counties. There are also additional caves in Santa Barbara and Ventura counties. An extensive bibliography is included.

Paper No. 18 is a report by Wallace and Taylor on a rockshelter on Cash Creek, 5 miles east of Yreka, Siskiyou County, California. The site was discovered over 50 years ago, relocated in 1949, and excavated by amateurs at various times in 1949, 1950, and 1951. Representatives of the UCAS excavated at the site in November, 1950. The shelter showed no stratification. Artifacts found at various times were made available to the UCAS for study.

A total of 493 artifacts were examined. Objects included: 193 projectile points of 8 types, scrapers, drills, knives, metates, pestles, and hammerstones, a total of 286 stone artifacts; 21 bone objects; 3 olive shell beads, 28 objects of wood including arrow foreshafts and shafts, a fire drill, and an awl; 143 objects of plant fiber, including basketry and mat fragments and cordage; 3 clay objects, and 9 miscellaneous objects including buckskin and sinew, 2 seed beads, and 2 quartz crystals.

There was a large amount of mammal bone. Identified fragments include coyote, bobcat, ground squirrel, gopher, wood rat, rabbit, deer, mountain sheep, and domestic cattle. Domestic cattle is represented by one tooth found in the upper 6 inches of the shelter. Vegetal remains identified include oak, manzanita, Sierra juniper, camas, lily, dogwood, buckeye, horsetail, round tule, and pine resin.

The authors conclude that the shelter was used occasionally by hunting parties or wandering families. The artifacts are similar in type to those of the surrounding ethnographic groups of the late prehistoric and early historic periods. The shelter may have been in use for 100 or more years. A trait list comparison shows that of 39 traits, 32 were shared with the Achomawi, 31 with the Modoc, 27 with the Atsugewi, 25 with Eastern Shasta, 21 with Western Shasta, and 19 with the Wintu. The basketry of the shelter showed specific correspondences with the Achomawi and Modoc. This suggests that the shelter may have been used by hunting parties from the east or northeast, or that the inhabitants were Eastern Shasta strongly influenced by their neighbors across the mountains.

The plates show the shelter and a plan of the shelter, projectile point types, basketry and matting, objects of wood, and examples of cordage.

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Nomlaki Ethnography. Walter Goldschmidt. UCPAAE 42 (No. 4): 303-443, University of California Press, Berkeley and Los Angeles, 1951. Pp. viii + 140, 3 text figs., 1 map. $1.50.

For archaeologists the notable feature of this thorough and undoubtedly excellent report on the Central Wintun is the concise summary of pertinent archaeology, in the nearby Patwin territory, with several comments on traits which can be traced into ethnology, thus relating the prehistoric material to living people. "There is considerable conformity between the ethnological data on the Nomlaki and the culture pattern of the Late period described by the archaeologists . . . no startling disconformities . . . it may be assumed that a local development (possibly stimulated from the outside) took place during the centuries preceding the first white contact, gradually forming into the culture known from ethnographic accounts. Another aspect of the archaeological record is highly suggestive of the kind of historical changes that occurred. Certain traits in the Late phase are associated with the wealth complex among the Nomlaki: . . . the wealth complex was associated with the secret society and the pattern of occupational specializing. This wealth complex was an institutional development that has every appearance of having been superimposed upon an earlier and simpler pattern of familistic-village organization . . . into the area from the south, . . . where the secret society was more highly developed. Furthermore, the analysis of the Nomlaki secret society made in chapter ii shows it to be a part of the Kuksu system. The archaeological data and the ethnological evidence from the Nomlaki support the historical reconstruction made by Kroeber (1923) . . . the Kuksu system was relatively late" (pp. 304-5). A paragraph on the evidence of skeletal material follows, and then one reconstructing rapidly, in essential outline, the prehistory of California.

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NOTES AND NEWS

SOUTH AMERICA

PERU. Louis M. Stumer has undertaken a large scale project of excavation in the valley of Lima and neighboring areas, concentrating on sites of the "Interlocking" period, roughly contemporary with the Gallinazo and Moche styles on the North Coast. The Interlocking style has received comparatively little attention from archaeologists and little was known about it beyond its general stratigraphic position when Stumer began his project.

Stumer's first excavations (June-August, 1952) were at Playa Grande, a one-period habitation site on the desert coast about two miles south of Ancon. He dug one house site, tested a large rubbish mound, and excavated twelve burials in a cemetery in the center of the inhabited area. Following the work at Playa Grande, Stumer turned his attention to Marquez, a well known but little studied site on the Chillon River between Ancon and Lima. Marquez is a much larger site, and was occupied over a longer period than Playa Grande. It has a good sized trapezoidal temple as well as habitation areas and cemeteries. Stumer has tested all of these (September-December, 1952), working partly in collaboration with Richard P. Schaedel who has now extended his survey of ancient Peruvian architecture to the Central Coast. One very spectacular discovery was a long wall painting on one of the interior walls of the temple, executed in six colors; some seventy feet of it have been uncovered at the date of writing. An account of this find appeared in the *New York Times* of January 20, 1953 (p. 27, col. 5).

Stumer's work, which includes surface collecting at a large number of Central Coast sites as well as the excavations described, throws much light on debated chronological problems as well as on Interlocking culture in general. Definite results must, of course, await completion of the project, which will involve excavation of at least one additional site. Present indications are, however, that the "Interlocking" of Chancay, Playa Grande, and the Chillon Valley forms a separate style, distinguishable from the "Interlocking" of the Lima Valley (Maranga, Nieveria) and Pachacamac, although there was considerable mixing of the two late in the sequence. So far, no White on Red has turned up south of Chancay Valley, and this style may turn out to be a local one in Chancay. Modelling and negative painting occur in Playa Grande Interlocking, perhaps as an influence from the North Coast, and there is also clear Classic Nazca influence on some pieces. A strain of blackware is found throughout the whole Interlocking development. The potential importance of research such as Stumer's for tying together the North and South Coast sequences cannot be exaggerated.

CHILE. Francisco L. Cornely, Director of the Museo Arqueologico of La Serena (address: Casilla 125, La Serena) reports that the Museum is currently concentrating on investigations of the El Molle culture, considered to be the oldest one yet found in the La Serena area. The type site of this culture is the cemetery of El Molle in the Elqui Valley, discovered by Cornely in 1938. El Molle is followed in the local sequence by the Chilean Diaguita culture, of which four phases are distinguished: Archaic (Las Animas cemetery); Transitional (Altovalsol cemetery); Classic; and Inca influenced. Cornely dug additional burials of the El Molle culture in the Elqui Valley in December, 1952, and Jorge Iribarren has excavated for the Museum a new series of El Molle graves in the neighboring Limari Valley, further extending the area of occupation of this culture. Cornely published a substantial monograph on the Chilean Diaguita culture in September, 1952 (see "Some Recent Publications," this issue), and he promises one on El Molle for early 1953.

A new building for the La Serena museum is under construction and will probably be occupied this year. It will house history, palaeontology and fine arts collections as well as archaeology.

SOUTHWEST

The Museum of Northern Arizona is observing its twenty-fifth anniversary in 1953, an occasion that will be marked by an expansion both in the staff and in the buildings. Malcolm Farmer, now studying for his doctorate at the University of Washington, will become Assistant Director on July 1st. He succeeds E. D. McKee, who will become Director of Research. Katharine Bartlett, who has been Curator of Anthropology, will become Anthropologist and Curator of Books and Records, and Robert C. Euler, who is completing work on his Ph.D. at the University of New Mexico, will assume the Curatorship. A new one-story building will be erected at the Research Center of the Museum, providing about 12,000 square feet of floor space to house the study collections of anthropological and biological material, the museum library, laboratories, and offices. All study collections will be moved from the present Museum building and the galleries thus freed will be used for exhibition.

PLAINS

Robert L. Stephenson has been Acting Chief of the Missouri Basin Project, Smithsonian Institution, at Lincoln, Nebraska, since the accidental death of Ralph Brown in September, 1952.

Thomas F. Kehoe has been appointed Assistant Curator at the Museum of the Plains Indian, Browning, Montana, and has initiated an investigation of bison-drive sites on and about the Blackfoot reservation with the aid of funds from the Bureau of Indian Affairs.

Herbert W. Dick of the University of Colorado Museum excavated a Dismal River site in Elbert County, Colorado, in May and June, 1952. Ten circular pit houses containing typical Dismal River pottery and other

artifacts were found. In addition two small Upper Republican sites were found in the vicinity.

The 10th Plains Conference for Archaeology, with Carlyle S. Smith as Chairman, was held in the Laboratory of Anthropology at the University of Nebraska from November 27 to 29, 1952. Aside from field reports and general papers there were three symposia: Early man and Woodland Occupations of the Plains, Marvin F. Kivett, Chairman; post-Woodland Village Cultures of the Plains, Franklin Fenenga, Chairman; Plains Ethnohistory, G. Hubert Smith, Chairman. E. Mott Davis was elected Chairman for the next conference. The papers and symposia will be published in the *Plains Archaeological Conference Newsletter* in 1953.

The field reports covered the work carried on by the Smithsonian Institution and by cooperating agencies receiving funds from the National Park Service in reservoir areas throughout the drainage of the Missouri River. Space does not permit the summary of all of the reports. Of special interest was William Mulloy's report on a lithic site (48CK7) in Keyhole Reservoir, Wyoming. The sequence at the site parallels those found at Signal Butte, Pictograph Cave, Birdshead Cave, and Promontory Point.

Arnold Withers presented a detailed report on his work in eastern Colorado in which he described several foci and pointed out connections between the Southwest and the Plains.

Noteworthy among the data and interpretations presented in the symposia was Richard Wheeler's attempt to divide the lithic cultures into those which had economies based exclusively on hunting and those based on hunting and gathering. Wesley R. Hurt reported that Woodland burial mounds seem to be concentrated along the eastern border of South Dakota. They tend to thin out toward the west and none has been found west of the Missouri River. Donald J. Lehmer demonstrated that the village cultures appearing in post-Woodland times in South Dakota may be assigned to two early groupings, Central Plains and Middle Missouri, and a later grouping, Coalescent. Central Plains appears to represent a northward thrust by the peoples bearing the Upper Republican and Nebraska cultures. The occupants of the area invaded by the southern peoples followed cultures such as the Over, Anderson, and Monroe foci which form part of the Middle Missouri grouping. As the name implies, Coalescent is the result of the blending of Central Plains with Middle Missouri. Coalescent designates the cultures of the Protohistoric and Historic Arikara, Pawnee and others.

Preston Holder drew upon his ethnological research to present data which has a bearing on the archaeology of South Dakota. Using documentation from historical records he traced the movement of the Arikara up the Missouri River. In outlining the culture of the Arikara he emphasized various traits which might appear in the archaeological record.

PACIFIC COAST

An anthropological museum has been established at the University of Idaho. Exhibits, classrooms, and laboratory spaces are arranged so that anthropological activities can be coordinated.

In Utah Jack Rudy has completed a report of a two year survey in western Utah. The paper is in press. Dee C. Taylor has completed an analysis of material from Garrison, Utah. His report will appear as an Anthropological Paper. J. D. Jennings is continuing work on the material from the Wendover caves. Additional field work in the area is planned for the summer of 1953. A survey of the Beef Basin-Ruin Park area, southwest of Moab, Utah is planned for the summer.

Plans are being formulated at the University of Washington for further work on the Columbia River during the 1953 summer field season. The Department of Anthropology, University of Washington has suffered a great loss with the death on December 26, 1952 of Dr. Daniel Sutherland Davidson, Professor of Anthropology.

Charles E. Borden reports continued work at a site on the Musqueam Reserve, adjacent to the University of British Columbia, Vancouver, B.C. The levels being worked at present are late. Material excavated includes abrasive stones, thin ground slate knives, bone awls, bird bone tubes, parts of composite toggling harpoons of two types (a. a flat triangular cutting blade of slate, b. a smaller toggle with slender bone point, oval to circular in cross-section), heavy duty wood working tools, including antler wedges and fragments of stone hand mauls. Two fixed projectile points with low barbs, one of antler and one of bone were found. These types have been found in lower levels in the sites of the area. Chipped stone implements are virtually absent in the level being worked. In earlier work evidence of chipping was found, and it is hoped that more evidence will be forthcoming from the deeper levels of the Musqueam Reserve site now being worked. Borden will conduct no field work in the 1953 summer season. He plans a trip to Europe to gather data for a course on Prehistory of the Old World.

Walter Kenyon, University of British Columbia student, has started a survey of the Lower Fraser Valley. A stone vessel with a skillfully sculptured human head at one end was found in a test at one site. The specimen is similar to a type found by H. I. Smith. (See H. I. Smith: Shellheaps of the Lower Fraser River, AMNH-M:3:4:184:Fig. 53b.)

R. F. Heizer, University of California, Berkeley, reports completion of a number of reports on previous work. R. Squier and G. Grosscup reported on 163 sites in the Modoc Lava Beds. All the sites appeared to be within the Late Horizon. Pictograph sites were abundant. J. Bennyhoff summarized data on 348 sites in Yosemite National Park. The sites were found at elevations from 1600 feet to 10,700 feet. Bedrock mortars were associated with the black oak-yellow pine

zone. Eighty-two percent of the sites of this zone had mortar rocks nearby. Of forty historical sites reported in Yosemite Valley, thirty could be related to archaeological remains with at least some probability.

The University of California Archaeological Survey crew undertook a limited survey of Shasta territory in October. Thirty-one sites were recorded on the Klamath River and its tributaries, fourteen with historic names. One of the named villages will be excavated in April.

Excavations were continued by the UCAS at the new Early Horizon site, Sac-168. The site is stratified culturally and physically, with a "hardpan" layer separating the Early and Late horizon occupation. A representative sample of artifacts have been found. Baked clay objects include one crude vessel. Two foothill sites near Le Grande, California have been recorded. Grooved and pecked petroglyphs, bedrock mortars and pitted boulders were found.

M. Harner has completed a preliminary analysis of the archaeological material from a trash filled well site at Bouse, in western Arizona. This site should be of value for data on the Yuman pottery sequence. There are also Hohokam sherds at the site.

ERRATUM

In "Material Culture of an Upper Coulee Rock Shelter," *American Antiquity*, Vol. 17, No. 4, pp. 352-9, by John E. Mills and Carolyn Osborne p. 357, column 2, 2nd line from bottom, should read: "in thirty-one specimens the fibers . . . "; p. 358, column 1, table, should read: "*Apocynum* with separated fibers — 31 specimens."

NOTE

The membership list of the Society for American Archaeology would normally be published in this issue. It is being held for publication with the account of the meetings of the Society, in Vol. XIX, No. 2, October 1953.

NOTE

ARCHAEOLOGY IN THE GALAPAGOS

The January 1953 issue of *American Antiquity* (Vol. 18, No. 3) reported the discovery of a stone face in the interior of Floreana (Charles) Island, Galapagos. It has otherwise been generally assumed that there is no archaeology in this isolated oceanic group. An archaeological survey of the Galapagos Islands, recently carried out by Thor Heyerdahl with the assistance of Erik K. Reed of the U.S. National Park Service and Arne Skjölsvold of the University of Oslo, ascertained that the reported stone face consists of a naturally shaped waterworn rock on which eyes and nose have been carved in recent years.

The expedition did, however, discover an archaeological site at Black Beach on the same island, as well as one in James Bay at Santiago Island (also known as James Island or San Salvador) in the same group. The findings consisted primarily of numerous fragments of pre-Spanish Indian pottery, representing among others known pre-Inca styles, as well as flint scrapers. Local conditions would not permit the preservation of organic matter over centuries, nor would the soft local tuff stand up to long lasting erosion. Both sites are on the coast, but with near access to two of the most dependable inland waterholes. The Galapagos Islands are within easy range of aboriginal balsa raft voyagers from the northwestern coast of South America. A full report of the Galapagos material is to be published.

1952 VIKING FUND MEDALS AND AWARDS

Archaeology

chosen by

The Society for American Archaeology

DR. ALFONSO CASO

General Anthropology

chosen by

American Anthropological Association

DR. JULIAN H. STEWARD

Physical Anthropology

chosen by

American Association of Physical Anthropologists

DR. WILLIAM L. STRAUS, JR.

Award Citation

ALFONSO CASO Y ANDRADE

As one of the leading researchers and administrators in the Mexican area, Dr. Caso has set a high standard for archaeologists and has earned the respect of his colleagues. He is especially to be commended for (1) his long series of excavations at Monte Alban and other sites in Oaxaca, resulting in such publications as *Las estelas Zapotecas* (1928), *Culturas mixteca y zapoteca* (1941), and, during the past year, *Urnas de Oaxaca* (with Ignacio Bernal), which constitute our major source for one of the most important sections of Meso-America; and (2) his organization of round tables, meeting every two or three years and attended by both Mexican and North American scholars, to discuss the problems of Meso-American archaeology. In his own research, Dr. Caso has maintained an enviable breadth of interest ranging from chronology through cultural reconstruction to artistic interpretation; and among his associates, he has instilled a very definite sense of problem which is largely responsible for the high quality of archaeological research in his country.

SOME RECENT PUBLICATIONS

A	*Antiquity*. Newbury, Berkshire, England.
AA	*American Anthropologist*, n.s. Menasha.
* *AEUS*	*Archeology of Eastern United States*, ed. by James B. Griffin. Chicago: University of Chicago Press.
AHG	*Antropología e Historia de Guatemala*. Guatemala.
AMNH-AP	*American Museum of Natural History, Anthropological Papers*. New York.
APS-P	*American Philosophical Society, Proceedings*. Philadelphia.
Ar	*Archaeology*. Cambridge.
ASC-B	*Archeological Society of Connecticut, Bulletin*. New Haven.
ASNJ-B	*Archeological Society of New Jersey, Bulletin*. Trenton.
ASV-QB	*Archeological Society of Virginia, Quarterly Bulletin*. Staunton.
* *AT*	*Anthropology Today, an Encyclopedia Inventory*, prepared under the chairmanship of A. L. Kroeber. Chicago: University of Chicago Press.
BAE-B	*Bureau of American Ethnology, Bulletin*. Washington.
BBAA	*Boletín Bibliográfico de Antropología Americana*. Mexico.
CA	*Cuadernos Americanos*. Mexico
CGJ	*Canadian Geographical Journal*. Ottawa.
CIW-CR	*Carnegie Institution of Washington, Department of Archaeology, Current Reports*. Cambridge.
CIW-NMAAE	*Carnegie Institution of Washington, Notes on Middle American Archaeology and Ethnology*. Washington.
CIW-P	*Carnegie Institution of Washington, Publications*. Washington.
CM-AN	*Carnegie Museum, Archeological Newsletter*. Pittsburgh.
CNHM-B	*Chicago Natural History Museum, Bulletin*. Chicago.
E	*Ethnos*. Stockholm.
EP	*El Palacio*. Santa Fe.
FiA	*Fieldiana — Anthropology*. Chicago.
FlA	*Florida Anthropologist*. Gainesville.
GR	*Geographical Review*. New York.
IAS-J	*Iowa Archeological Society, Journal*. McGregor.
ICA-P	*International Congress of Americanists, Papers*, 29th. Chicago.
INAH-M	*Instituto Nacional de Antropología y Historia. Memorias*. Mexico.
ISAS-J	*Illinois State Archaeological Society, Journal*, n.s. Springfield.
ISM-SP	*Illinois State Museum, Scientific Papers*. Springfield.
K	*Kiva*. Tucson.
KAS-P	*Kroeber Anthropological Society, Papers*. Berkeley.
M	*Man*. London.
MARR	*Middle American Research Records*. New Orleans.
Mas	*Masterkey*. Los Angeles.
MAS-B	*Massachusetts Archaeological Society, Bulletin*. Attleboro.
MiA	*Minnesota Archaeologist*. Minneapolis.
MoA	*Missouri Archaeologist*. Columbia.
NH	*Natural History*. New York.
NMC-B	*National Museum of Canada, Bulletin*. Ottawa.
NMM	*New Mexico Magazine*. Santa Fe.
OA	*Ohio Archaeologist*, n.s.
OSAHQ	*Ohio State Archaeological and Historical Quarterly*. Columbus.
P	*Plateau*. Flagstaff.
PA	*Pennsylvania Archaeologist*. Honesdale.
PAC NL	*Plains Archaeological Conference, News Letter*. Lincoln.
PMAAE-M	*Peabody Museum of American Archaeology and Ethnology, Memoirs*. Cambridge.
PMAAE-P	*Peabody Museum of American Archaeology and Ethnology, Papers*. Cambridge.
RAE	*Revista de Arqueología y Etnología*, 2. época. Havana.
RMEA	*Revista Mexicana de Estudios Antropológicos*. Mexico.
S	*Science*. Washington.
SA	*Scientific American*. New York.
SAA-M	*Society for American Archaeology, Memoirs*. Salt Lake City.
SAP-J	*Société des Américanistes de Paris, Journal*, n.s. Paris.
SAS-PB	*Sociedad Arqueológica de La Serena, Publicaciones, Boletín*. La Serena, Chile.
SCN-M	*Sociedad de Ciencias Naturales La Salle, Memorias*. Caracas.
* *SiA*	*Science in Alaska, Selected Papers of the Alaskan Science Conference*, ed. by Henry B. Collins. Washington. Arctic Institute of North America.
SIS	*Southern Indian Studies*. Chapel Hill.
SJA	*Southwestern Journal of Anthropology*. Albuquerque.
SL	*Southwestern Lore*. Boulder, Colo.
SM	*Scientific Monthly*. Washington.
SMC	*Smithsonian Institution, Miscellaneous Collections*. Washington.
T	*Tlatoani*. Mexico.
TA	*Tennessee Archaeologist*. Knoxville.
TAPS-B	*Texas Archeological and Paleontological Society, Bulletin*. Lubbock.
TRB	*Tree Ring Bulletin*. Tucson.
U	*Univer*. Jalapa, Veracruz.
UCAS-R	*University of California Archaeological Survey, Report*. Berkeley.
UM-ASP	*University of Montana, Anthropology and Sociology Papers*. Missoula.
USD-MN	*University of South Dakota, Museum News*. Vermillion.
UU-AP	*University of Utah, Anthropological Papers*. Salt Lake City.
VFPA	*Viking Fund Publications in Anthropology*. New York.
WVA	*West Virginia Archaeologist*. Moundsville.
YU-PA	*Yale University, Publications in Anthropology*. New Haven.
ZE	*Zeitschrift für Ethnolo[illegible]e*. Braunschweig.

* Coded for this issue only.

EDITOR'S NOTE:

Over 450 titles are included in this feature this year. The search for titles is done entirely by the ASSISTANT EDITORS. The coding, arranging and editing, from cards supplied by the EDITORS, for this and the previous two volumes have been done by Miss Marian Sheets, Instructor, Library Science, University of Utah.

GENERAL

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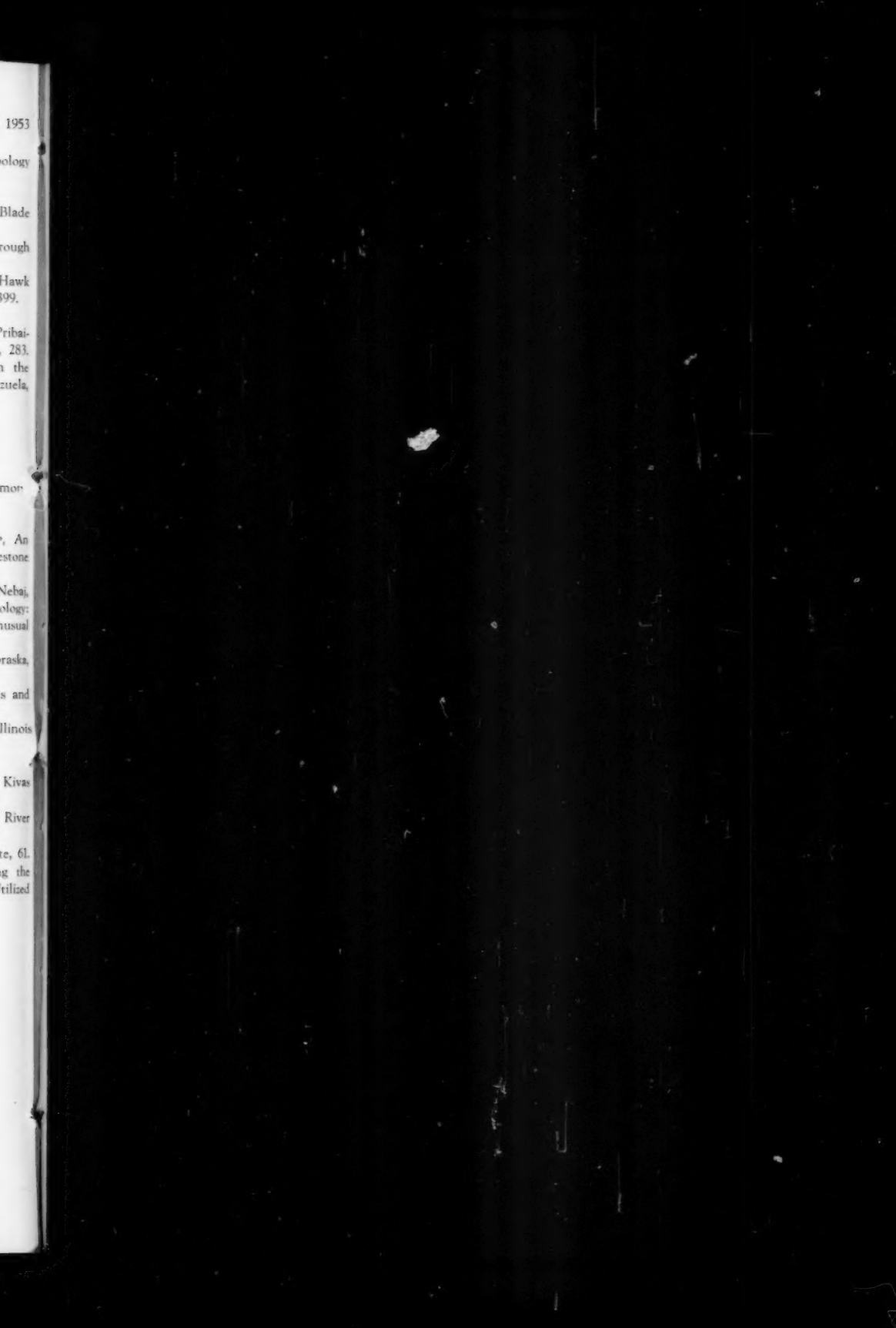

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